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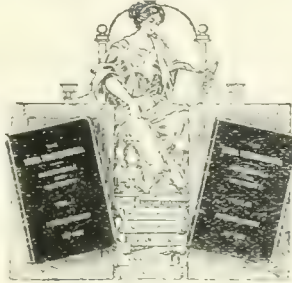
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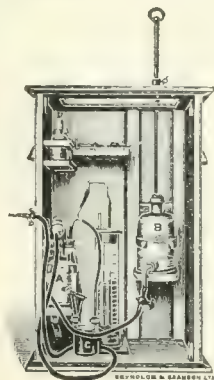
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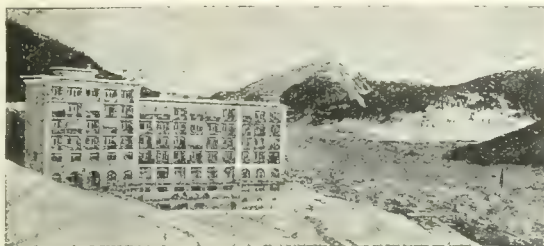
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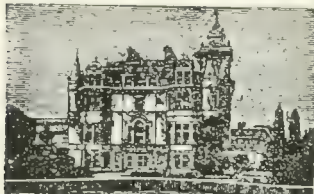
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FOR DESCRIPTION

OF THE AMBULATORY TREATMENT OF TUBERCULOUS JOINTS BY
HÖEFTCKE'S EXTENSION SPLINT, SEE PAGE LXXXVII, TOWARDS
THE END OF THIS SPECIAL NUMBER OF "THE PRACTITIONER"

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 in Securing Oral Asepsis.

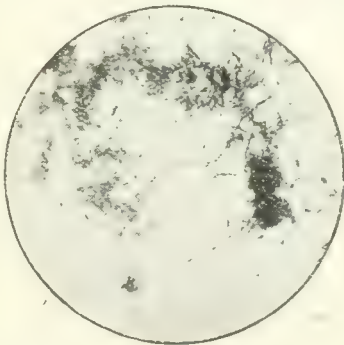
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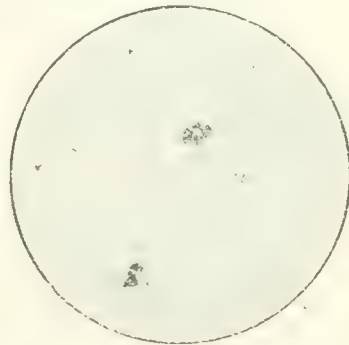
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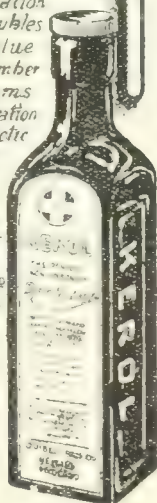
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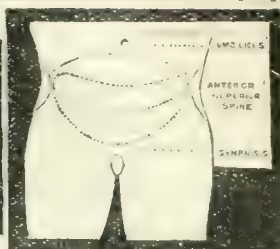


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'ROCHE'

A SOLUBLE GUAIACOL COMPOUND

IS A PALATABLE, ODOURLESS, NON-IRRITANT AND NON-TOXIC PREPARATION WHICH ENABLES THE PHYSICIAN TO INTRODUCE LARGE QUANTITIES OF GUAIACOL INTO THE SYSTEM WITHOUT GASTRIC DISTURBANCES.

IN PHTHISIS whether the case is in the incipient or advanced stage the action of 'Thiocol' is exceptionally advantageous. *It alleviates cough, reduces night-sweats and effects a great improvement in the appetite and general condition of the patient.*

IN THE CASE OF CHILDREN 'Thiocol' can be employed with much success; with the addition of a little Syrup of Orange a mixture may be obtained which will be readily taken by even the most fastidious.

'Thiocol' is also recommended for the treatment of Bronchitis, Laryngitis, Whooping Cough and all Broncho-Pulmonary Complications.

Vide: "Practitioner," Nov., 1911. "'Thiocol,' A Clinical Study." (H. G. Cole.)

DOSE: 5-15 GRAINS.

OBTAINABLE OF ALL PHARMACISTS IN:

Powder, 3/- per Bottle of 1 oz.
Tablets, 5/- " " " 100
 " 1/6 " " " 25.

Descriptive literature and sample on application.

THE HOFFMANN-LA ROCHE CHEM. WORKS, LTD.,
 7/8 IDOL LANE, LONDON, E.C.
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MÖLLER'S HYDROXYL-FREE COD LIVER OIL.

The only Cod Liver Oil which can be continuously administered without causing any gastric disturbances so common in all ordinary oils and emulsions.

OF ABSOLUTE PURITY.

Entirely free from the decomposed fats or hydroxylated compounds which cause nauseous eructations, therefore is

EASILY RETAINED AND ASSIMILATED.

As a food for both children and adults it is unequalled. In all wasting diseases, rickets, tuberculosis, the most reliable restorative.

MEDICAL OPINION:

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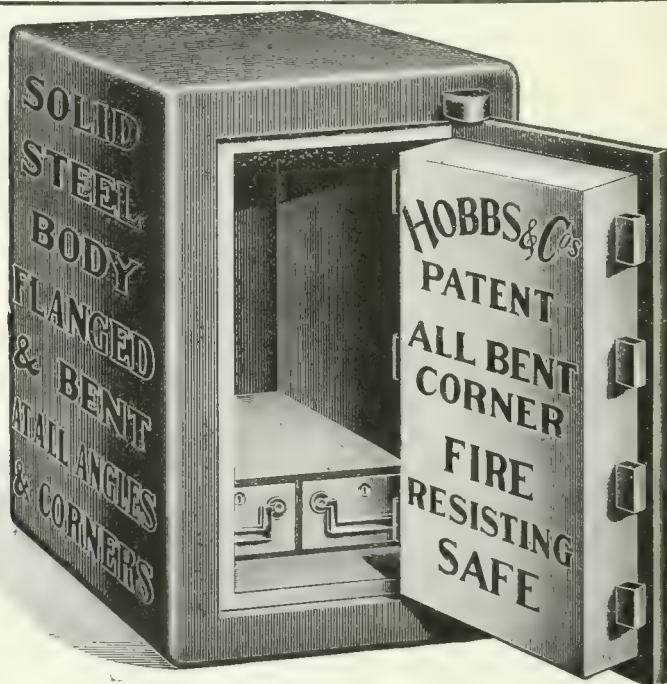
The Medical Review.—"It is quite unexcelled."

Medical Press.—"A most excellent and valuable preparation, and does not cause the objectionable 'repeatings' we are so familiar with in certain brands."

Sample and full particulars sent free.

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NEURITIS—

is generally admitted to be a condition as productive of acute suffering as it is intractable. Modern investigation of the etiology of the disease has yielded no evidence sufficient to warrant a departure from the widely accepted view that the disease is due to an altered blood condition (caused by the presence of toxins) which produces degeneration of the finest branches of the peripheral nerves.

Neuritis is being treated extensively, and with exceptional success, by the following formula :—

Ext. Lymphatic Glands, Testes,		Glycero-Phosphate Sodium	
Brain and Spinal Cord	... gr. 2	and Calcium	... gr. 2
Glycero-Phosphate Iron	... gr. $\frac{1}{2}$	Aloin (when indicated)	... gr. $\frac{1}{10}$ th

The above is the Standard Formula of the

LYMPHOID COMPOUND

(LOWENTHAL)

(IN SOLUBLE CAPSULES)

Clinical experience, constantly repeated, conclusively demonstrates that when Neuritis is idiopathic or follows Metabolic disorder, Chill, Influenza, Worry or Fatigue, or when it is associated with Diabetes, Gout, Anæmia, or Cachectic states, then degeneration, vaso-motor, and trophic changes are arrested, while pain and tenderness disappear as a direct result of the pronounced tonic, eliminative, and compensatory action of the treatment.

A recent report (typical of many others) reads as follows :

" I have had a further success with the Lymphoid Compound (Lowenthal). The patient, *æt.* 49, had been a sufferer from acute Neuritis in her left arm for nearly six years, when she called me in. I found the muscles of the arm considerably wasted, and the skin atrophic. The cause of the neuritis appeared to have been acute and prolonged mental strain, extending over three years. At times her pain was extremely acute and it had persistently prevented sleep; indeed she only obtained natural sleep when thoroughly worn out. I tried almost all the known methods of treatment of Neuritis, including fixation of the limb for eight weeks, dieting, baths, radiant heat and light, electricity in various forms, external applications and internal medication, but all to no purpose. After six months of this I put her on to the Lymphoid Compound Capsules (Lowenthal), prescribing three Capsules per day. She had three hundred Capsules in all before her symptoms had entirely disappeared. One year has elapsed since she took the last Capsule, and there has been no return of the Neuritis. She is in excellent health, sleeps well and eats well. Her arm has regained its normal size and the skin is no longer atrophic.

I may say that in two other cases of apparently intractable Neuritis, I have, by similar treatment, secured equally happy results.

L.R.C.P., L.R.C.S. (Lond.)

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According to *Prof. Dr. Rosenbach*,
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has proved very successful in Pulmonary and Surgical Tuberculosis, particularly Tuberculosis in children and Lupus. Confirmed by many years' experience.

The subcutaneous injections even in the larger doses are borne well. Quick recovery from fever; increase in weight; improvement of general health.

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According to *Dr. Carl Spengler, Davos*, for specific treatment of tuberculous diseases. The initial doses consist of weak solutions of I.-K. original solution, which are gradually increased to 1 c.cm. of the original solution. Absence of by-effects, such as fever, quick pulse, etc.

I.-K. is polyvalent in the sense of the duality and plurality of the infection respectively.

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BARLEY, WHEAT AND MILK
In Powder Form.

IN WASTING DISEASES

Hundreds of physicians appreciate its high quality. It is distinctive and inimitable. It means stringent milk regulations, malt in which the enzymes have been properly developed, a clean sun-flooded plant with sanitary surroundings, and many years of experience. A food that may be of vital importance to some infant under your care that is not gaining in weight. Supplies the essential nutriment for stimulating life forces in the treatment of Febrile Diseases, Malarial Cachexia, Incipient Tuberculosis and all cases of Systemic Weakness.

PREPARED IN A MOMENT WITH WATER. NO COOKING.

Samples by post, free to the profession, on request.

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After professional skill has succeeded in carrying the patient over the crisis of a serious illness, the regular use of "WINCARNIS" will promote a speedy convalescence and a rapid return to health.

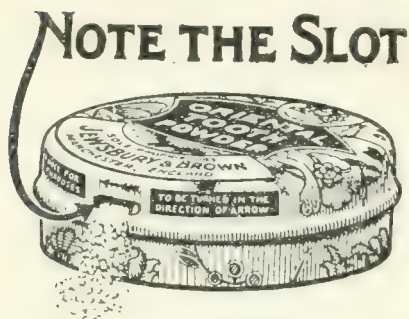
After serious illnesses—particularly after Influenza—"WINCARNIS" is especially valuable, as it can be easily administered, and is readily assimilated by even the most debilitated stomach.



The use of "WINCARNIS" is also indicated in cases of Debility, Anæmia, Depression, Physical and Mental Prostration, Sleeplessness, etc., and is warmly recommended and prescribed by over 10,000 Doctors. A trial bottle of "WINCARNIS" will be sent free to Doctors on receipt of application to

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**Promotes
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The BEST
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Savory and Moore's Peptonised Milk is of the greatest value as a food in all cases of **INFANTILE MALNUTRITION**, also in cases of **FEVER** and **WASTING DISEASE**, whether in children or adults. It is retained even when no other kind of food can be taken, and by its nutrient qualities enables the patient to assimilate sufficient nourishment to successfully combat disease. In many cases it has been the means of saving life, especially among infants.

The Peptonised Milk is absolutely sterile, and free from preservatives other than pure sugar. Dilution with hot or cold water, as directed, renders it ready for immediate use.

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A Sample of the Peptonised Milk, which will allow of a thorough trial, will gladly be sent to any member of the Medical Profession or any Medical Institution, on request. Address:—

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IN PHTHISICAL SYMPTOMS.

As a supplementary treatment the following capsule has shown marked effect in minimizing the presence of septic organisms, the streptococci and staphylococci which excite any existing inflammation in the lung tissue:—

FORM :

Glycero-phosphate of Quinine - ℥ i
Benzoate of Potash - ℥ i
Tinctural Benzoin - ℥ i
Fluorinated Sodium Chloride - ℥ i

A Prophylactic and tonic in Catarrh of the Throat, Nose and Pharynx, Bronchial Pneumonia, Relaxed or Sore Throat and Lungs.

Glycero-Phosphate of Quinine is the most stimulating of all salts of Quinine, anti-febrile and tonic.

Creosote Benzoate is anti-catarrhal expectorant, diuretic and the least irritating of all combinations of creosote.

DOSE :

One every hour in acute cases, otherwise one or two capsules 4 times a day.

Original bottles of 50 and 100 capsules.

Free sample sent to *The Practitioner*.

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SQUIRE'S TERPEROIN ELIXIR is particularly indicated in the cough of PULMONARY PHTHISIS, in acute and chronic bronchitis, and in diseases of the respiratory organs. It is also valuable in asthma, emphysema, and laryngeal catarrh.

The following are also prescribed with marked success in respiratory troubles :—

Glycero-Terperoin.

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BURNEY YEO'S RESPIRATOR.

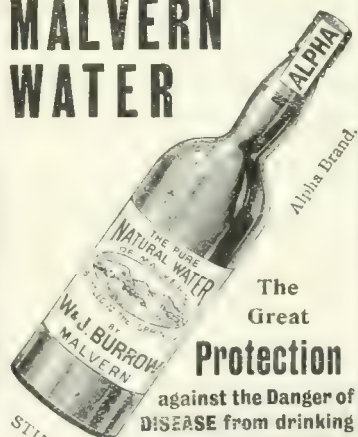
An improved respirator, adapted for continuous antiseptic inhalation, as recommended in the Bradshaw Lecture (B.M.J. '12, ii. 1272). This respirator is invaluable in the treatment of the physical signs of incipient PULMONARY TUBERCULOSIS.

Write to Dept. C. for a descriptive leaflet to the full series of SQUIRE'S TERPEROIN PREPARATIONS, and a précis of literature on continuous antiseptic inhalation.

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The
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THE PUREST AND SOFTEST
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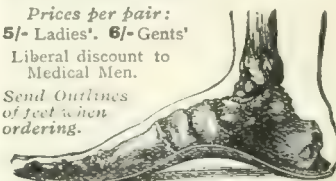
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Prices per pair:
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of feet when
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The Spleen contains a Hormone which decidedly influences Nutrition—

Nutrition is of paramount importance
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Splenic Extract is a valuable adjunct remedy
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inforced with trypsin, amylopsin, and calcium lactate,
based on the work of Dr. Bayle of Cannes (France)
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On request, interested physicians will receive literature and
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"Ovaltine" is a particularly valuable agent in super-alimentation. It is of high caloric value; does not burden the digestive functions; and is tolerated over long periods despite anorexia.

"Ovaltine" has been found to be a great help in Phthisis. It improves nutrition; 'builds up' and restores tone; and increases opsonic and recuperative powers.

A Supply for clinical trial will
be gladly sent to any Physician.

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Eczema, Erythema, Pruritus

Successfully treated by

ECSÖLENT COMPOUND

MEDICAL CONFIRMATION RECEIVED.

Read what "The British Medical Journal" says:—

January 21st, 1911.



"Ecsölent Compound is of great value in the treatment of itching eruptions, especially about the anus and genitals, and the Powder has proved an excellent application in cases of troublesome intertrigo in the folds under the breasts, on the abdomen and elsewhere. In addition to our own limited but decidedly favourable experience, we have had submitted to us a large body of authentic evidence spontaneously offered by practitioners throughout the country. Their statements refer chiefly to cases of **Eczema, Erythema, Psoriasis, Pruritus Ani**, and various other skin affections. The names and professional position of those who testify to the usefulness of the Ecsölent Compounds are sufficient guarantees of their good faith."

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Samples and Full Particulars Sent Free to the Medical Profession.

Medical men are invited to apply for samples. They will be sent free of charge and post paid in response to the Coupon, or to a request by letter. This will enable a proper test to be made.

SIGN THIS FORM FOR FREE SAMPLES

And send to Ecsölent Compounds, Ltd.

Dr.

Address

PRAC., Jan. 1913.

In addition to the Free Sample of the Ecsölent Compound, free samples of the Ecsölent Powder and Ecsölent Soap will also be sent free and post paid. They can all be had afterwards from Chemists.

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(Seed of Strength)

A POWERFUL NERVE AND BRAIN FOOD.

"WISEM" consists of milk casein and whey powder, with 3 per cent. of pure lecithin-ovo, and 3 per cent. of glycerophosphate of soda.

The casein used is made from milk produced on some of the finest pastures in the Kingdom by a special process, which yields a pleasant flavour, and retains the proteins in a soluble state. It is also rich in soluble organic phosphorus.

The food value of whey is well known, but hitherto it has been impossible to reduce it to a powder without coagulating the lactalbumen.

Both the lactose and lactalbumen, as well
as the enzymes, are retained unchanged
in the whey powder used in "WISEM."

When "WISEM" is prescribed we submit that whatever may be the idiosyncrasy of the individual, an assimilation of a considerable quantity of phosphorus is assured owing to the presence of the two forms, where one alone might fail to have the desired effect.

"WISEM" is supplied in tablet form slightly flavoured with chocolate, the tablets being the most convenient form in which to take it. If desired the tablets can be broken up finely and dissolved in water. Each tablet contains one grain of pure lecithin and one grain of glycerophosphate of soda.

1/6 per Tin of 24 Tablets.

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**IS USED IN LEADING
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Benger's Food is expressly devised to be used in conjunction with fresh Cow's Milk, alone or diluted. Prepared according to the directions, it provides a readily tolerated, and easily assimilated fluid diet of high food value.

The composition of the prepared food will vary with the amount of Dry Food, Milk, or Milk and Water used, and the length of time allowed for digestion.

**WHERE A FOOD CONTAINING A HIGH
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this may be obtained by the addition of Cream, or use of Upper Milk. Prepared Benger's Food can be made to contain from 3 to 6 per cent. of fat if desired.

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Benger's Food	$\frac{3}{4}$ oz.	<i>Approx. percentage Composition</i>	
Water	2 fluid ozs.	Protein	3.98
Mix and add according to the directions.		Fat	4.20
Upper two-thirds Milk, Half a pint.		Sugars	8.56
Set aside to digest for the desired time (say 15 to 30 minutes) then boil and allow to cool.		Unconverted Starch, from 1:00 to 1:50, according to length of digestion given.	

Almost any desired proportions of proteins, fat, and sugars may be obtained by variation of the formula, and full particulars will be willingly furnished on application to

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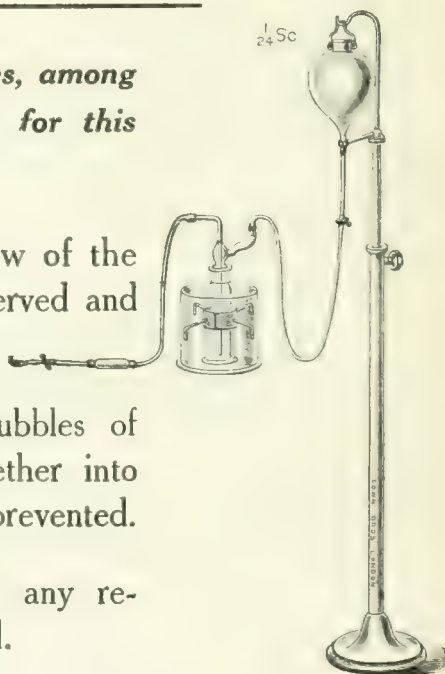
Apparatus for Intravenous Anæsthesia Ether, Hedonal, &c.

Suggested by Mr. E. G. SCHLESINGER, M.B., B.S.

(Vide "GUY'S HOSPITAL GAZETTE," May 25th, 1912.)

The following advantages, among others, are claimed for this apparatus :—

1. The exact rate of flow of the solution can be observed and controlled.
2. The admission of bubbles of air or evaporated ether into the circulation is prevented.
3. Warning is given of any re-gurgitation of blood.



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THE IDEAL ANTISEPTIC & DISINFECTANT.

MEDICAL IZAL

NON-POISONOUS.**NON-CORROSIVE.****Does not cause irritation.****Does not coagulate albumen.****1 in 900 destroys the *staph. pyogenes aureus* in five minutes.****Definite germicidal power guaranteed.**

FOR INTERNAL USE.

Indicated in chronic dyspepsia, fœtid bronchitis, foul stomach, diarrhœa, dysentery, cholera and typhoid fever.

IN PUERPERAL SEPSIS.—“Out of 79 cases of Puerperal Sepsis treated by general means alone, with or without intra-uterine douches, 37 died—a mortality of 46 per cent. In 86 cases where the method of using Izal I have described was employed, the mortality was 23 per cent. only.”—*Journal of Obstetrics and Gynecology*, January, 1907.

FOR EXTERNAL USE.

Indicated in eczema and ringworm.

Verbatim Reports and Samples Free to the Profession.

NEWTON, CHAMBERS & Co.,
THORNCLIFFE, near SHEFFIELD. Ltd.,

NATURAL CARLSBAD SPRUDEL-SALT

Prepared only by the Municipality of
Carlsbad from the World-famous
"Sprudel" Spring at Carlsbad

(In Crystals or Powder)

Is the Only Genuine CARLSBAD SALT



Largely prescribed in cases of Chronic Gastric Catarrh, Hyperamia of the Liver, Gall Stones, Chronic Constipation, Diabetes, Renal Calculi, Gout and Diseases of the Spleen, arising from residence in the Tropics or Malarious districts.

As the NATURAL SPRUDEL-SALT in Crystals deliquesces at a temperature of 88° Fahrenheit, the Sprudel-Salt in Powder Form will be found more convenient, seeing that it is not affected by high temperatures or exposure to the atmosphere.

Medical Practitioners should kindly note, when prescribing, to specify "NATURAL Carlsbad SPRUDEL-Salt" on account of the many artificial preparations upon the market.

The wrapper round each bottle of genuine Salt bears the signature of the Sole Agents—

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Samples and Descriptive Pamphlet forwarded on application.

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THE CINNAMIC ACID ESTER OF GUAIACOL.

There is complete agreement among clinicians that guaiacol is as easily absorbed from Styralcol as it is when pure guaiacol is prescribed; but Styralcol possesses the advantages of a pleasant taste and non-interference with the appetite. It is, therefore, possible to introduce very large quantities of guaiacol into the organism by means of Styralcol, without the risk of causing any injurious or troublesome secondary effects.

The investigations made with Styralcol in cases of *incipient phthisis* are remarkably noteworthy. In these cases there was also an immediate abatement of the expectoration, general strength increased, and the subjective condition improved. Therewith the other symptoms, *i.e.*, physical depression, rise of temperature, and night-sweats, etc., also diminished. It finally has an excellent effect in putrefactive intestinal catarrh.

Styralcol possesses a definite influence on the mucous membrane of the *throat and bronchi*. The liberated guaiacol acts on the mucous membrane as an anæsthetic, and thus relieves the cough. At the same time it develops a powerful bactericidal action, thereby preventing further infection.

In *rheumatoid arthritis* it has been found most useful, if administered in sufficient quantities and for a sufficiently long period.

Styralcol is issued as powder in boxes of 1 oz. and $\frac{1}{2}$ lb. and as tablets ($7\frac{1}{2}$ grains) in tubes of 15 and boxes of 150.

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is one of the first essentials for the cure or prevention of Tuberculosis.

The use of gas for fuel in place of coal ensures an atmosphere indoors that is free from the dirt inseparable from coal-fires, and prevents the atmosphere without from becoming fouled with smoke.

By the steadily increasing use of gaseous fuel for cooking and heating, the hours of sunshine in our great cities are being annually increased.

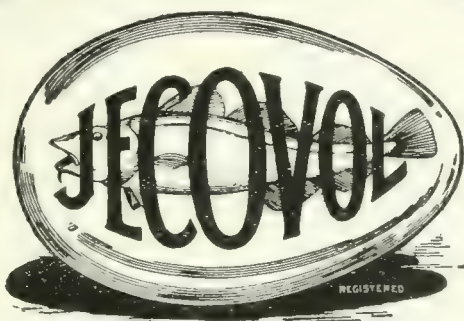
It is a striking fact, that, as a result of practical experiment and experience, the number of Medical Men in one district of the Metropolis who are satisfied that the gas fire is hygienic as well as economical, cleanly as well as convenient, and as essential in cases of sickness as it is comfortable at all times, has increased in four years from under 1,000 to over 2,500.

Full information respecting Modern Gas Fires, which are artistic in design and economical in cost, will be readily furnished on application to Dept. U. 16.

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A PERFECT EGG EMULSION



PALATABLE — EASILY-DIGESTED — NUTRITIVE,
RESTORATIVE,

Composed of 50 PER CENT. of the finest

NORWEGIAN COD LIVER OIL,

carefully emulsified with fresh yolk of egg,
and each fluid ounce containing six grains of the

GLYCEROPHOSPHATES

— OF —

CALCIUM, SODIUM, and IRON.

Dose :

Adults : — 1 to 2 tablespoonfuls.

Children : — 1 to 4 teaspoonfuls.

"For those who cannot take the ordinary forms of Cod Liver Oil, Jecovol will prove an effective substitute. It will be welcomed by children and delicate patients. We believe this elegant emulsion will be of real value in the treatment of many cases of tuberculosis."—*The British Journal of Tuberculosis*.

JECOVOL is sold in 4-oz., Half-pint, and One-pint Bottles,
price 1/-, 2/-, and 3/6 each, retail.

May be prescribed through all Pharmacists,

JAMES WOOLLEY, SONS & CO., Ltd.,

Manufacturing Chemists,

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GLAXO IN TUBERCULOSIS

Cases of early Phthisis are often rendered patent by recurrent attacks of gastritis. In these patients, Glaxo on account of its high food value and the ease with which it is digested is a valuable article of diet. In cases of advanced Phthisis with much vomiting, Glaxo is well borne by the patients even when they "turn against" ordinary cow's milk.

In all cases of **Surgical Tuberculosis** in Children, GLAXO is not only indicated, but, once given, the young patients ask for it. Since it is so palatable and refreshing on account of its small curd, its standardized composition and bacteriological purity, GLAXO is the Ideal Food in all febrile conditions in the young.

Though recent legislation trends towards the improvement of the milk supply, yet the present condition of things leaves much to be desired. Therefore it behoves the profession to make use of the purest milk at hand.

GLAXO

consists only of milk, with extra cream and milk sugar; it contains Lactose, a high percentage of fats, Albumin (6.06 per cent. soluble), and Mineral salts.

Will **YOU** try **Glaxo** if we send a sample free and carriage paid? If so, send one of the post cards enclosed in this issue to

GLAXO,

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124/7, Minories, E.C.

*"Beautifully Cool
and Sweet Smoking."*

Player's Navy Cut Tobacco and Cigarettes

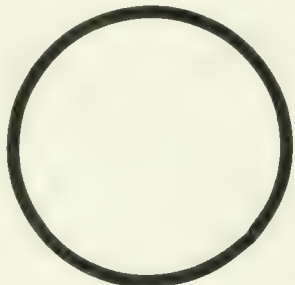
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PACKETS AND TINS AND MAY
BE OBTAINED FROM ALL STORES
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“in the employment of a poultice for the relief of pain and inflammation, it is most essential that a sterile and trustworthy product be applied.

“That skin affections have been added to the original disorder when bread-and-milk or linseed poultices have been used to relieve pain, emphasizes the employment of antiphlogistine, not only as a superior hot moist dressing, but because it is both clean and sterile.

“That moist heat is, when properly applied, a most valuable factor in the



treatment of inflammation, whether deep or superficial, is generally accepted and that antiphlogistine is the most adaptable and satisfactory method of realizing thermic value seems to be acknowledged by professional preference.”



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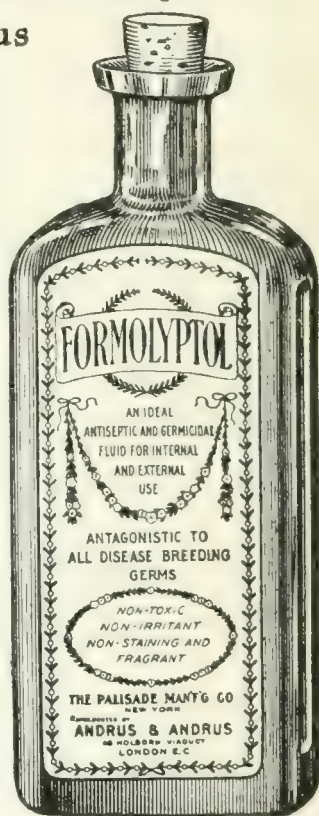
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The Original and

Relieves the distressing cough.
Allays digestive disturbance.
Promotes assimilation.
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Pulmonary Phthisis of medium gravity. Mrs. Berta K., 27 years of age. The patient had undergone a course of tuberculine treatment in a sanatorium 18 months previous, with good results, but unfortunately did not remain there long enough. Having now had a relapse, she desires to repeat the treatment. There is, however, a difficulty, namely, that as soon as the tuberculine dose is increased in the least degree she suffers from abnormal re-action. The irritating cough becomes unbearable and her general condition and appetite deteriorate greatly in consequence. On combining the tuberculine treatment

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Palatable—almost like cream.
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Can be administered in any vehicle.
Does not spoil or grow rancid.

With the administration of Angier's Emulsion, the reaction after the injections became much milder, especially as regards the symptoms complained of. In fact, it was the Emulsion alone that rendered it possible to follow the tuberculine treatment correctly. During this treatment, the patient actually gained 9 lbs. in weight, commencing from the first administration of the Emulsion, which increase is solely attributable to the Emulsion, because previously the tuberculine injections caused such loss of appetite that an increase in weight was quite out of the question.

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The numerous enquiries which we have received as to the various forms of Tuberculin on the market have led us to endeavour to bring into the compass of a short pamphlet such information on the subject as can be usefully dealt with in the space available. We shall be glad to send a copy of this pamphlet to any medical man on request.

The whole *rationale* of the tuberculin treatment is fully dealt with in "Evans' Journal"—

No. 1. July, 1912.—"The History of Tuberculin and its Importance to the Medical Practitioner."

No. 2. October, 1912.—"Tuberculin as a Diagnostic Agent."

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The tubes are of pure tin and are filled with the sterilized injection under special conditions. The empty tube may be discarded and the needle kept for future use.

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(Amylthiotrimethylamine)

has stood the test of time, and is now extensively used in all types of Tuberculosis. It gives far better results than any other known remedy in Pulmonary and Glandular Tuberculosis, Tuberculous Joints, Lupus Vulgaris, mixed infections, etc. Not seldom acute cases, too, respond to its action. It may be employed with perfect safety, since it does not cause any irritation locally or constitutionally. [*Vide The Lancet*, March 30th, 1912, p. 897, and leading articles of the *Medical Times*, Sept. 30th, 1911, p. 781 *et seq.*]

•

The Medical Superintendent of East Anglian and Maltings Farm Sanatorium, Suffolk, writes :—"Total number 31. Of these, two have died and showed no alteration one way or the other from the treatment—they were very advanced cases—leaving 29. Of these, no one was worse for the injections, nor was there any local disturbance. A case of double antrum disease with a raised temperature, who was operated on both nasally and by the mouth with little permanent benefit, was very much improved in all ways by the injections. She was more vigorous and began to put on weight, which she had not done previously. One long-standing chronic case, who had many other things in the way of special treatment, has much improved in general condition, and the physical signs have diminished considerably. A case of pulmonary abdominal tuberculosis that was at a standstill and gaining no weight has steadily put on weight since her injections, and is much improved in general condition. Generally speaking, cases have shown diminution in cough and expectoration, lowering of temperature, and improvement in general condition."

Dr. J. P. M., late medical partner to Dr. Otto Walther, of Nordrach, Black Forest, Germany, and Medical Superintendent

PNEUMOSAN—continued.

of the Devon and Cornwall Sanatorium for Consumptives, has favoured us with the following observations :—

“Over one hundred cases have been treated so far. The instructive and interesting point about them is the short time that they were under treatment, and that they were able to return to their various businesses on leaving the Sanatorium. I am getting better results since using Pneumosan than ever before. I would point out that cases in the first and second stages respond best to Pneumosan, although I have had good results in more advanced cases, but these results are not so general or so certain. One is morally bound to take notice of a preparation like Pneumosan when the patients all ask for it, because they say they feel so much better from its administration, and when one sees the improvement in appetite, temperature, cough, and general well-being in nearly every case.”

PNEUMOSAN IN TUBERCULOUS JOINTS :

“I cannot praise Pneumosan too highly for use in tubercular joint and bone disease. An ulna, which I scraped, and which was obstinate in healing, speedily healed. Two knee-joint cases of a severe type—one I opened and dried, the other was scraped and had five drainage incisions left, are both doing remarkably well. The latter came into hospital in July, and will be discharged in a few weeks with the joint healed, stiff and immobile, wearing a Thomas knee splint. I do not hesitate to say that the end of this case under other treatment would have been twelve months or more of drainage, or more probably amputation.—V. J. G., M.D., M.B., Ch.B.”

PNEUMOSAN IN TUBERCULAR CERVICAL GLANDS :

“Miss V. A., age 21.—Had four operations during the last 3-4 years, also Sanatorium treatment. Cod-liver oil and Syr. Fer. Iod. In spite of all this fresh glands were always coming. She consulted me 2½ months ago. She had :—Chains of small glands on both sides of the neck ; one the size of a walnut in the left supra scapular focus and dulness round the left pulmonary apex.

She was cured by 30 injections of Pneumosan. She had a suppurating wound in the neck, which quickly healed up. The glands diminished in size and improvement in colour, appetite and strength

Pneumosan. Announcement also on previous page and next two pages.

PNEUMOSAN—continued.

and increase in weight were all manifest by the end of the first series of 10 injections. She is very contented and exceedingly gratified.—N. N., M.D."

PNEUMOSAN IN LUPUS VULGARIS:**(PRELIMINARY REPORT.)**

"F. . . . 8 years old. I am using Pneumosan in a very extensive and severe case of Lupus vulgaris. The lesions are on the right leg from foot to groin. Von Pirquet's reaction was very positive, and it is lupus without a doubt. In the first month she gained 8 lbs. from 37 to 45 lbs., but since then her weight has remained stationary. She is plump and looks well. The lesions are some quite healed, others are progressing finely; those on the feet are slower to heal, but they were the worst, verrucous a centimeter at least high, crusted and angry. There is a remarkable difference in the appearance now. All the lesions are healing, but I think she will need 6 or 8 weeks more to cure. She has had no other treatment than Pneumosan, not even ointments to keep the dressings from sticking. No internal treatment at all. I have careful notes at the Hospital and shall write up the case and of course give your remedy all glory. I have given no other treatment so as to get full value of the test.—W. B. A., Professor of Dermatology."

PNEUMOSAN IN ACUTE TUBERCULOSIS:

"S. C. French. 20 years.—In February 1912 was seen and complained of persistent hacking cough, occasional slight attacks of hæmoptysis and night sweats with fever. *Examination.*—Crepitations over apices of both lungs. Small cavity formation at left apex. Sputum teeming with tubercle bacilli.

Treatment.—Pneumosan injections started at once with the doses recommended. Microscopical examinations of the sputum were done every 10 days. After the first series patient's general condition somewhat improved. Tubercle bacilli were as before. In March a second series was commenced, the doses used being 10 minims for the first five doses, and 15 minims for the second five. The physical signs in the chest were less easily made out and the T.B. were lessened in a marked degree. Cough still present. No hæmoptysis. In April the third series was given; the doses being as in the second series. The general improvement was

Pneumosan Announcement also on two previous pages and next page.

PNEUMOSAN—continued.

maintained, the cough less troublesome, and hæmoptysis absent. The physical signs were less apparent. T.B. were present in steadily decreasing numbers on each examination of the sputum. In May a fourth series of injections was given, the doses given at each injection being 15 minims. Under this dosage the patient improved greatly and all the physical signs disappeared with the exception of some dulness at the left apex. There was no fever and little cough, no hæmoptysis and no night sweats. The sputum presented T.B. but in very small numbers, and it was necessary to search seven or eight fields before a single bacillus was found. The case has been remarkable throughout and shows a rapidity of improvement which I know of under no other treatment. A further series of injections will be made in the course of the next month.—R. P. C., M.B., B.C. Cambridge."

**PNEUMOSAN IN ACUTE TUBERCULOUS
ULCERATION OF THE VOCAL CORDS:**

"I tried your Pneumosan in a very rapid Tuberculous ulceration of the vocal cords. Patient had great pain on swallowing, night sweats and small hæmorrhages, loss of weight; also a few crepitations at apex of right lung. So much for condition of patient before treatment with Pneumosan. Almost from the first few injections the patient began to feel better, more comfort on swallowing, and smaller hæmorrhages. After the second course patient's voice much stronger; before she could only speak in whispers. After third course, to quote the patient's own words: 'I'm quite well now, doctor,' cough almost gone, voice natural, no temperature, no night sweats; put on weight, could take quite long walks without that feeling of lassitude, which she formerly had. I think it is simply marvellous.—R. W. McA., M.B."

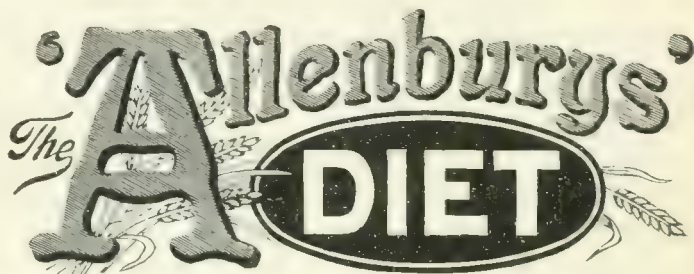
PNEUMOSAN is issued in Bottles containing 13.14 grammes of the drug. Price 15/6 per Bottle, carriage paid to any part of the United Kingdom. A Special Syringe, made to hold the maximum dose, with two needles, in neat case, 5/-. Literature free on application.

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The "Allenburys" DIET is made from pure milk, rich in cream, and whole wheat, both ingredients being largely pre-digested during manufacture. It can be taken by those who cannot digest cow's milk, and provides a light and very nourishing diet for **Invalids, Dyspeptics, and the Aged.**

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ilated even when the digestive organs are impaired.

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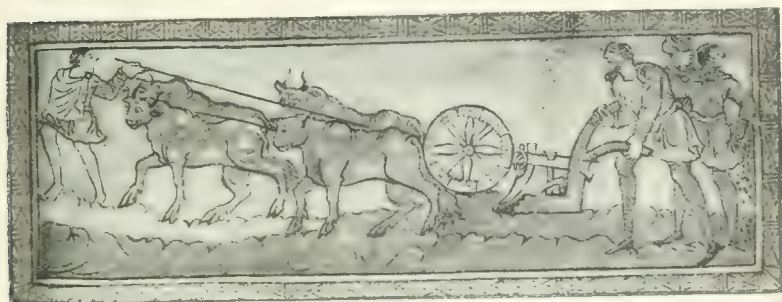
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PLOUGHING. From an early MS.

January



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shedding water,
And is good to take purgacyon,
And is indifferent to let blode."

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'WELLCOME' BRAND TUBERCULINS

Issued in two strains—Human and Bovine—for use
according to the source of infection suspected.

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„New Tuberculin (W) (Human or Bovine), in phials of 1 c.c. in four strengths of tubercle bacillary substance:—0·00001 mgm., 0·0001 mgm. and 0·001 mgm., at 9/2; and 2 mgm., at 8/0, per phial.

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„Old Tuberculin [Human (T.) or Bovine (P.T.)]. In phials of 1 c.c., five strengths:—0·0002 c.c., 0·001 c.c., 0·01 c.c., and 0·1 c.c., at 1/0; and 1 c.c., undiluted, at 1/3, per phial.

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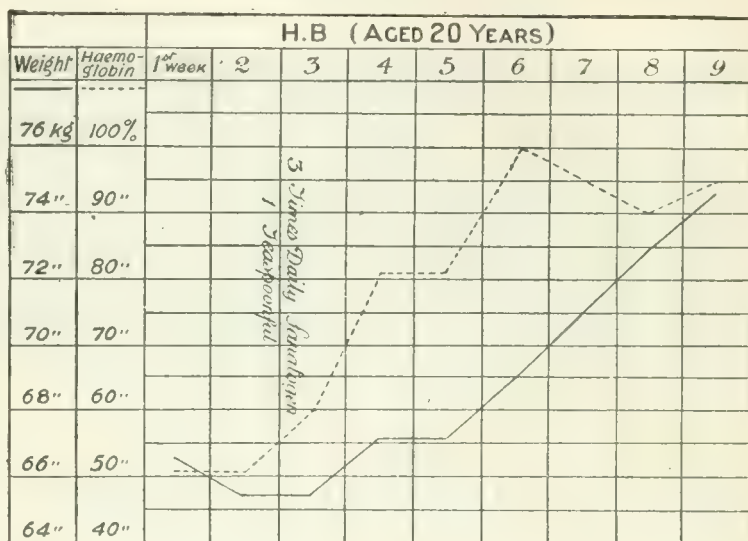
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SANATOGEN IN SANATORIA.

*Extracts from an article by Dr. F. Starkloff (Belzig Sanatorium),
from "Zeitschrift für Tuberculose," 1911, No. 6.*

"I have devoted my attention to that extremely well attested preparation, Sanatogen, and have obtained from it, in the Belzig Sanatorium, very good, and in some cases brilliant, results. I have ordered Sanatogen for patients who were in a state of bad nutrition, and whose weight remained at a standstill or tended to decline. In most cases a marked increase in weight followed rapidly, sometimes this increase was gradual but sustained, sometimes it took a sudden leap. I had, on the other hand, a few failures, but these were, without exception, in cases of very advanced phthisis. In general, I have observed an improvement in appetite, a return of strength and a rise in physical and psychical well-

being. Especially striking was the excellent effect of Sanatogen on all kinds of neurasthenic troubles, which so often encumber those suffering from phthisis. The patients treated with Sanatogen also developed a rapid increase in the hæmoglobin content of the blood.

"My investigations lead to the conclusions that Sanatogen should occupy a permanent position in our Materia Medica. I consider it proved that this preparation has acquired a very significant reputation as an adjuvant in the treatment of phthisis."

The accompanying chart illustrates one of the many cases recorded by Dr. Starkloff.

THE PRACTITIONER.

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Special Number on Tuberculosis.

INTRODUCTION.

By SIR T. CLIFFORD ALLBUTT, K.C.B., M.D., F.R.C.P., D.Sc.,
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THIS number of THE PRACTITIONER is, by a select series of articles, to represent, as far as may be, the activities, the accomplishment, and the promise of the hive of workers busy more and more on this tremendous problem. I have read carefully all these articles; they are written by men who have a first-hand and first-rate conversance with the subject as a whole, and especially with the part of it which each has most intimately studied. These several fields of research will be recognized by their titles; they cover all parts of the subject, the overlaps are very few, and the essays are, on the whole, pregnant and concise. The Controlling Editor of THE PRACTITIONER has asked me to make some reflections upon them, and this I propose to do under the customary divisions.

The hereditary aspect of tuberculosis takes no great space: congenital tubercle is treated as little more than a curiosity; and if one or two writers are disposed to ignore the influence of heredity, others confine it to an inheritance of defective resistance. Dr. Horder says that the existence of tuberculous families is one of the cardinal facts in clinical medicine, and I agree with him; but, on this point, I am disposed to make one or two remarks. I would oppose the too frequent assumption—not by the present writers—that the victims of tuberculosis are after all weaklings whose weeding out, if painful to their friends, is, on the whole, good for the stamina of the race. It is true that by inheritance, or by privation, a person may be so debilitated as to offer a lessened resistance

to any injurious influence from without ; but, on the other hand, in respect of tubercle such a lack may mark a family from generation to generation, as a peculiarity rather than a frailty ; or, at worst, as a flaw which is open to one kind of stress only. Such a constitution is as a lock, which may be shut to every key but one. Bar the tubercle, and such an one may continue strong and beautiful.

Again, we do not know whether this peculiar lack is always or only a constitutional defect ; it may lie in some local peculiarity in a vigorous body by which the way is open to the entrance of tubercle hither or thither. Such a peculiarity may be found in the particular bronchiole of Hirschfeld, which in certain families is apt to sag, and thus to make a dip in which the bacillus may defy the cleansings of nature. Such a tube may be more defective on one side of the chest than on the other ; and Turban showed, accordingly, that a tendency to pulmonary tubercle is not only an inherited proclivity, but in this family or that predominates on one side or the other. In one family it is prone to begin at one apex, in another family at the other apex.

I am glad to see that the misleading metaphor of the "soil," against which for years I have protested, is at last falling into disuse ; it scarcely occurs in these essays. Such metaphorical phrases are to be eschewed. A "soil" does not do its utmost to attack and repel the seed sown in it. In respect of the degree of immunity in children, there is a curious inconsistency between some of the authors and others. For instance, in two of the best articles of the series, Mr. Robert Jones says, "Children under the age of 15 have a high degree of immunity" ; while Dr. Eric Pritchard argues, that the absence of reaction in children is a sign in them of inactive defences. Surely this is a point not too difficult to be soon decided ?

We are all agreed that one of the bottom factors in the prevalence of tuberculosis is housing. Dr. Glaister points out forcibly that broken-down houses too often mean broken-down occupants ; and, as Sir John Moore puts it, it is too often the home rather than the house which is at fault. Still, we know that the house and the occupant act and react one upon the other ; that a bad house degrades its inhabitants.

And, I think, we are apt to forget that fresh air means to very poor people more expense in clothing and firing than they can meet.

The routes of invasion by tubercle are yet much in dispute. Many are the experiments which should elucidate the problem. On this question Sir Richard Douglas Powell, Dr. Walter Carr, and Dr. Acland write with authority. The fundamental doubts seem to lie between the milk- and the air-advocates. Sir R. Powell and Dr. Horder remind us that the bacillus will live long even in dry dust; and Dr. Carr reminds us that the little child inhabits the floor. Dr. Acland does not reckon the probable price of milk under his strict provisions, and Dr. Carr remarks that tuberculosis is prevalent in many a country, as in the East, where there is no milk. But the discussion of routes of entry involves us in that of the identity of the bacillus, on which we find here no very new information. We must not forget that milk may contain the human as well as the bovine microbe. Two or three years ago, when on a Home Office mission, I visited a close and rather dirty cottage where the occupier, a man in advanced phthisis, had been set up by his kindly mates in a small milk-walk! His milk vessels were uncovered.

On the other hand, Dr. Carr impresses upon us the findings of the Royal Commission in respect of the mischievous nature of the bovine bacillus; that, for instance, the inoculation of the bovine variety from man into a calf has the same effects as the bovine from calf to calf; that the anthropoids are as readily infected with the bovine as with the human variety; that about half the abdominal lesions in man, and a large proportion of the scrofulous lesions, reveal the bovine variety. The bacillus of pulmonary tuberculosis, on the contrary, is rarely bovine. At Midhurst practically all our bacilli are of the human type. Dr. Pritchard, in considering children, seems to find the bovine form in smaller proportion than one might have expected; so that *primâ facie* inhalation is suggested; and the bronchial glands, he adds, are affected as often as the mesenteric.

By the way, Dr. Horder still prefers the anti-formin method of detection; at Midhurst this method has been rejected for the sedimentation method of Ellermann and Erlandsen.

In the last years of the last century, by a small Committee led by Prof. Kanthack, we had organized a supervision of the Cambridge milk supply; the Colleges were subsidizing it, and the milk dealers had fallen in with it; when, therefore, at the London Congress in 1901, Koch declared for the harmlessness of the bovine bacillus, we heard him with dismay. As we feared, the Colleges cut off their subsidies, and the Committee's work came to a sudden end. Perhaps no distinguished man ever did so much harm by publishing an opinion so unconsidered.

While speaking of Kanthack, I may refer for a moment to "mixed infections." That, in phthisis, much of the mischief might be due to secondary infections occurred to him and to me; and we worked together in much hope on this hypothesis. However, we obtained no favourable results by vaccines. Mr. Jones, I see, speaking from the surgical point of view, is of a different opinion; he dreads secondary infection, and, when it occurs, finds much advantage from vaccines. In surgical cases, then, mixed infection may be of great importance, but in pulmonary cases this is not so. Professor Dixon, if he refers to the lung, makes, in my opinion, too much of mixed infection. For it appears from later experience—as, for instance, by our experience at Midhurst—that the reason why Kanthack and I failed was that, in phthisis, mixed infection is not frequent; when it occurs, it is a late and, no doubt, a very grave complication, but one that produces no diagnostic signs, symptomatic or opsonic. In one case at least, during last year at Midhurst, Dr. Radcliffe discovered that, in a mixed infection, the secondary growth was the *B. influenzae*.

In these articles, it is needless to say that anxious attention is given to early diagnosis. In 1898, after I had been working on tuberculosis at Leipsic with Birch-Hirschfeld, I became much impressed with the probability that many persons pass through an attack of pulmonary tubercle without knowing it; whether by virtue of resistance or by mildness of invasion, they suffer comparatively little, and their peril is not recognized. They are "off colour" for a while, or "overworked," or have a troublesome "catarrh" from which they recover. Since I brought this point of view before the profession, on opening the subject of phthisis at the meeting of the British Medical

Association in 1899, much additional evidence of its truth has accumulated. Some of these persons may be carriers, though in others the tubercle may remain long closed. Early diagnosis, therefore, is of primary importance.

To this subject, and to early treatment, Dr. Arthur Latham's paper is addressed, urging that by appropriate measures a cure may pretty surely be brought about in at least twenty per cent. of all cases. He urges that we must not wait for physical signs. At the meeting in 1899, I urged that definite physical signs signify not an early but an advanced case. If I venture to contribute two small remarks to Dr. Latham's indications, they are, first, that, while a subnormal temperature of a morning is suspicious, 98.5° at that hour is too high, and even more suspicious; secondly, that if a pellet of sputum can be secured from the little cough or hawking of the first movement in bed of a morning, the bacillus may be found in it; although not otherwise. Indeed, many such incipient patients scarcely cough again during the day. However, this morning cough may be but the irritation of a closed focus, and its sputum may not contain the bacillus.

The reader will look eagerly for some lead as to early diagnosis by tuberculin, but not altogether with reward. If he collects opinions from many writers in this series, he will find rather a discordant note; some of the authors are emphatically in favour of its use, others are more cautious, or more timid. At Midhurst the cases on admission are only too obvious, and no tuberculin test is necessary. Dr. Wilkinson's advocacy of this test in early diagnosis is well known, and is here enjoined again. Sir R. Powell is disposed to let sleeping dogs lie, and he reminds us of the large number of normal persons—relatively normal—who, notwithstanding, give a reaction. Dr. Latham also speaks with reserve. Mr. Jones thinks tuberculin the final judge of appeal; but he is guided not by a general but by a local reaction, which the surgeon, luckily for himself, can observe directly.

On one point there is a curious difference of opinion; namely, that, while most physicians seem agreed that the use of tuberculin in diagnosis is followed by an exacerbation, or at least an awakening, of the focus, Dr. Wilkinson denies this, and asserts that, on the contrary, it has a sedative

effect upon it. Those who think there is a local awakening generally comfort us by the assurance that this reawakening does no harm. It may do no harm in a focus already not inactive; it may even modify it in some favourable way; but what about some other focus, dormant and unsuspected, on the way to obsolescence? The general practitioner will desire some more solid assurances than are provided in these papers, before he will trust himself, for diagnostic purposes, to arouse reactions which might be injurious. There is too much at stake; and even for the expert the number of "normals" (or persons practically normal) who react is embarrassing.

Dr. Lawson speaks with enthusiasm of the sufficiency of X-rays in the diagnosis of incipient phthisis. It is not for me to say at what measure of certainty an interpreter of these phenomena may arrive, but an expert is not always at hand. For the rest of us, I think, are as yet far from the hope that our methods of physical examination, laborious and fallible as they may be, will be superseded by the screen. Dr. Pritchard writes that in children the ray method cannot be trusted for diagnosis in the incipient stage; in the stage, that is, when aid is especially needed. The screen, by the way, is far more helpful than the photograph.

Of the opsonin method, as a guide to diagnosis and treatment, Dr. Colebrook speaks confidently; Dr. Horder not so confidently. For my part, I think the method is valuable in research rather than in clinical application; the physician has other and readier methods. In any case, I have found it so open to ambiguities of personal equation, that no series of observations should be trusted which has not been carried out all through by one observer. Dr. Colebrook states, what Dr. Radcliffe at Midhurst also has found, that much depends upon a standard antigen. Dr. Horder's report on other detective methods, including fixation of complement, will be read with interest. On the clinical side, Dr. Latham lays stress upon tiredness as an early symptom, and every medical reader will recognize the truth of this warning. He adds that there is no more potent incidental cause of relapse than over-fatigue; I agree, and would add of initiation also.

The most important rule in prognosis is one on which Dr. Latham and Dr. Paterson insist; namely, that the prophet shall

be guided, not by the extent of the mischief done, but by the intrinsic resistance of the individual. Dr. Walters rightly says that he has more hopes of a patient with cavities and a strong resistance, than of one of weak resistance in whom the physical signs taken alone may be inconsiderable. And in all cases of prognosis, I would reiterate the warning of more than one of the essayists against too sanguine or too facile estimates of the course of the disease. From the time of my first visit to Bennet at Mentone, and soon afterwards to Unger at Davos, this duty was impressed on my mind. Both these physicians urged that, whatsoever the gifts of their respective climates, the mean duration of cure must be at least two years and a half. Is it not then our duty to lay this estimate clearly before our patients at the outset, that they may be prepared for the sacrifices which will be required of them; instead of buoying them up with delusive proposals of a few months in a sanatorium, and the like?

The special articles by Mr. Fenwick, Mr. Ormond, Sir St. Clair Thomson, and Dr. Milligan, on urinary, ophthalmic, laryngeal and aural tubercle respectively, will be read with the interest belonging to papers written by authors so skilful. Mr. Ormond says that disseminated choroiditis may be a result of tubercle; Sir St. C. Thomson that, by fresh air and silence, local applications, save the galvanic cautery, have been dispensed with. Dr. Theodore Thompson and Mr. Gordon Watson both write upon the peculiar tuberculous hyperplastic disease of the ileum, cæcum, and ascending colon; the only considerable overlap in the series. They point out its importance especially in respect of its not infrequent resemblance to carcinoma. Dr. Whiting, in his essay on tubercle and the nervous system, attributes the *spes phthisica* to tuberculous toxin, and says it is especially a manifestation of the later stages. This opinion some of us may hesitate to accept.

On treatment, happily, we find much that is of the highest importance and interest. The articles on surgery by Sir Pearce Gould and Mr. Robert Jones are as helpful as they are weighty. As regards small and inadequate explorations, Sir P. Gould says one might as well ask a housemaid to clean an apartment through the keyhole! Mr. Jones warns us that tuberculous joints cannot be exercised for the purpose of auto-inoculation; he warns us against promoting

cure of a limb without sufficient regard to its position when cured ; and adds that the reaction against complete rest may in these cases be carried too far. Mr. Gauvain, likewise, by his unrivalled experience at Alton, fortifies this by his success in spinal caries by suspension and fixation in plaster of Paris. His clear description of his method is illustrated by pictures, in which the pathetic faces of the patient little sufferers are not the least touching feature. A remarkable article on this side of the subject is that of Dr. Baetzner, on the trypsin treatment of surgical tubercle. I am not surgeon enough to form any judgment on this paper, but the claims made for the method are very great indeed.

To turn now to medical treatment ; and, first of all, to the curative applications of tuberculin, as the subject on which the practitioner will be most desirous of light. I think it will be found that although some writers are less sanguine than others, yet all of them admit that this agent cannot be left out of the reckoning. Sir R. Powell is cautious in his estimate of its use ; Dr. Priestley tells us to beware lest we be carried away too far on a wave of optimism concerning it ; he is, nevertheless, advancing towards the more intensive mode of administration. The divergence of opinion between such experienced writers, between those who press for the intense method and those who prefer the more gradual, or "reactionless," method, shows that we are not as yet in possession of adequate data nor of mature opinion. We do not derive from all the writers who deal with this subject an equal assistance. Mr. Allan Bennett, of the Torquay Tubercle Dispensary, gives us an exact description of his methods. He had tried the bolder methods, but found them harmful, especially in patients who had still to follow their occupations ; so that, of late, he has been driven back on the "reactionless" methods, and is convinced that thus he is getting better results. Dr. Camac Wilkinson's article, as we should expect, advocates a very different opinion. It is highly polemical, and so far rather fails in conviction. It does not conciliate the reader to find the "Johns-Hopkins' methods" called off-hand "timid and superficial." They may be so of course ; but in any case, so serious an assertion should be confirmed by something more than a gibe. Our difficulty is the greater as Dr. Wilkinson on his part does not give us any instruction in what the reader especially desires, namely, in

the precise details of his own practice ; we receive instead some rather familiar precepts of a clinical kind. Indeed, the author seems to warn the ordinary doctor off his ground, telling us that his method cannot be learned even in three months ; and that few men—not his own pupils—are fit to be trusted with it. At the same time, Dr. Wilkinson must be thanked for his support in pressing home the impropriety of appointing medical officers of health, as such, to posts for which experts in tuberculosis are required, and are essential to success.

It is true that the bolder, more intensive methods of treatment by tuberculin find other weighty advocates in this company ; Dr. Priestley is increasing his doses and shortening his intervals ; however, the prevalent opinion seems to incline to the contrary. Dr. Pritchard prefers the "reactionless" method for chronic cases, though he suggests that for some of them larger doses at shorter intervals may be better. Dr. Walters warns against the use of tuberculin in "ambulant cases," a warning which may limit the practice of the dispensaries. Moreover, during this treatment the patient is going about to infect other people. Mr. Jones, while admitting that slow, small dosage often fails, yet fears that larger doses may stir up a storm. He admits, however, that, not finding the need of the agent in his practice, his experience of it is not considerable. Dr. Latham thinks that cures under tuberculin, if continued for twelve months at least, are more permanent. Dr. Horder draws a contrast between the prophylactic and the anaphylactic principles in the vaccine, and foresees an elimination of the adverse principle. If I may travel out of these pages for a moment, I would remark that Dr. Winterbotham, late Resident House Physician at Victoria Park, in his thesis for the M.B. degree at Cambridge in 1912, reported a division of his cases into three classes : those patients who had been treated by ordinary methods, those by creasote inhalations, and those by tuberculin ; the results in the three classes were approximately the same.

At Midhurst, the staff have about 60 per cent. of the cases under tuberculin. Febrile cases receive it only when bed fails to reduce the fever ; *i.e.*, as a last resource. The aim is to reach the largest dose possible for the individual, and if possible to attain 1 c.c. in four months. But only about one

per cent. can tolerate this quantity before discharge. The method is not quite reactionless, as some signs are regularly looked for, and focal reactions, symptoms and signs are quite common; the same dose is then repeated. No antibodies seem to be thus generated in the serum. Dr. Raw advocates treatment by tuberculin in scrofula, in opposition to surgical interference. I may be prejudiced in favour of the operative method introduced by Mr. Teale and myself*; but I believe I have an open mind, for of late years, in not a few cases, I have tried tuberculin instead, but not with the same success. This method is far more tedious than the operation, is less efficacious, in case of rupture is more apt to scar, and may leave a dormant focus, or more than one, in the neck.

Auto-inoculation from the local lesion is discussed by more than one writer; six miles is taken as the full test by exercise. Dr. Paterson, whose experience in this respect is very large, advises us on several nice points: *e.g.*, when in exercise a temperature even of 100° may be disregarded; and in such exercises monotony is not to be regretted, because zeal is perilous. The workers are cheerful enough in spirits if they work in gangs. The first sign of too much auto-inoculation is loss of appetite. Sir St. Clair Thomson has observed no benefit from tuberculin in laryngeal tubercle.

Dr. Lillingston's description of the results of artificial pneumo-thorax will make here the impression it made upon us in Cambridge in his exercises for M.D. in 1911.

On sanatorium methods, we have of course much discussion. It is needless to say that every writer, on this part of the subject, denounces the vulgar error of regarding a sanatorium as a Medusa's cauldron, from which the sufferers emerge in health; as Dr. Walters says, the sanatorium is but a link, an indispensable link, in a chain of remedial means. If, as I have said, the cure of a case of phthisis is at least a matter of two years and a half, it would be impossible, were it desirable, to keep such patients for this length of time in any institution. One reason, which perhaps does not receive full recognition in these essays, is the slackening effect of such seclusion upon the character of the inmates. The concentration upon self, and upon personal signs and symptoms,

Internat. Med. Congress, 1884, and subsequent papers. This operation had been performed before, as we afterwards learned, by Mr. Rushton Parker.

is less hurtful than the detachment from the harder duties of life. Much of this evil may be averted by the systematic occupations which therapeutics as well as morals require, occupations so interestingly described by Dr. Paterson; still after a while, especially in persons not belonging to the class of hand workers, even these engagements begin to take an artificial form, and cease to have the bracing moral effect of serious work and family and social affections. Some effect of this kind seems inseparable from prolonged invalidism, but we must see to it that it shall be as little as possible.

While speaking of education, however, we may emphasize the teaching of our essayists that the sanatorium is not to complete cures of phthisis, but to educate the patient in the methods and reasons by which cure is to be compassed. For this purpose, perhaps, a residence of three months may suffice. Furthermore, Dr. Walters argues that every practitioner who desires to undertake the treatment of phthisical cases should himself reside for no less a period in a sanatorium! However, for the patients there is another difficulty, or a larger demand. As our staff at Midhurst is realizing more and more, if tuberculin is to have a fair trial, the patients must be worked up to a high degree of tolerance to this agent, perhaps to more than one kind of it. It takes twelve months to do this; but at present few patients can stay, or be permitted to stay, for so long a time. Thus, as yet, the opportunities for persevering with systematic treatment with tuberculin are few; moreover, the success achieved is too often lost on discharge.

Again, we desire to learn, by like systematic tests, how long the tolerance lasts. It is to be hoped that some arrangements may be made, of a national kind, for carrying out these individual observations. With this intention in mind, and for after cure—if we may speak of consolidation as “after” cure—Dr. Bardswell writes from the fulness of his experience on this necessary complement of sanatorium treatment. He wisely adds, that so long as the patient is doing well, it is better that his attention should not be riveted on himself by continual taking of temperatures. On this side of the subject, Dr. Priestley’s paper will be read with interest. Dr. Walters argues that home treatment, if really on sanatorium principles, is more expensive than sanatorium treatment; while Dr. Latham adds that it is, too often, a failure. Dr. Walters

indicates that these buildings need not cost more than £60 a bed ; and for doubtful or waiting cases, and for persons able to work, he sketches a plan of health camps. Dr. Priestley's "preventoria" for children come under a similar intention.

Many of us entertain an uneasy suspicion that, after all done by sanatoriums, the value of which, if only indirect, we would not forget, the fall in the tuberculosis rate hitherto is but little due to it, but may be accounted for by the improvements in housing and general sanitation. For, as the preceding paragraphs signify, we are compelled to set the infected at large again among the people. Those who have been in sanatoriums have been taught, no doubt, to take some precautions. But can we suppose that men and women brought up in careless habits can change these habits so completely as to avoid all risks to others ?

It may be true that the amelioration of the tuberculosis rate is greater among the well-to-do, only because their habits and their dwellings are more open to reform ; for even with them the spray of the cough is not all to be caught in flasks. And so long as we throw back the incurables upon the people, is not the bottom out of our systems ? Or, to use another metaphor, are we not sowing tubercle as fast as we may be weeding it out ? Dr. Acland insists on these reflections, and urges the usefulness of travelling exhibitions as means of education in the subject. Sir John Moore, Dr. Carr, and Dr. Priestley also write on the duty of segregating the incurable ; a principle in which we shall all be agreed ; but how ? Can we contemplate the removal of slowly dying men, women, and children to institutions over whose door is written "*Lasciate ogni speranza, voi ch' entrate*" ; to banish them from the last cares and solace of those dear to them ? What might be done is to take a few cottages amid their own streets or lanes where, under the care of nurses, their last days might be spent in familiar surroundings and not far away from their families.

On other means of treatment discussed in these pages, I have left myself little room to speak. The stuffing system, against which I ventured to protest at the time of the Nordrach boom, is now discarded, and Dr. Paterson smiles at the notion of these puffy bodies doing the work he would

require of them. The example of Nordrach should be put on its justifiable claims of close supervision, regulated exercise, and absolute obedience to the medical ruler.

On diet, Dr. Chalmers Watson advocates his well-known principles; and it may be added that the other writers on diet (Latham, Powell, Pritchard, Bardswell) also agree that for the tuberculous a relatively large proportion of protein food is necessary. Dr. Neville Wood's article on climate will be read with profit; and I observe that Dr. W. Gordon's assiduous researches into the effect of rainy winds receive respectful attention (Wood, Moore). On drugs, Professor Dixon tells us many things. He points out that, if tuberculous foci be extravascular, yet drugs move easily by diffusion. He discards the hypophosphites, which Dr. Alcindor approves. He leans to the essential oils, etc., as having virtue; which opinion goes to support the inhalation practice, cogently advocated here by Dr. Muthu, and elsewhere by Dr. Lees. The constitution of cod-liver oil is peculiar, and chemically adapted for our purpose. Calcium salts, if they are to be styptic, must be injected subcutaneously. Tonic bitters are for the mouth and need not be swallowed; but have we not sensory perception down to the foot of the œsophagus? Heroine is no better than codeine. But, as Sir R. Powell rather sadly says: it is for the incurables that drugs are most wanted.

Professor Glaister's article on the relation of tubercle to Public Health policy will be read with interest; and Dr. Horder goes so far as to declare that the difficulties of stamping out tuberculosis are not scientific, but wholly political and personal. Dr. Lister's article on life assurance raises the curious question whether a person who has defeated tubercle in his own body, may have thus proved himself a better life. I have said that one of our Midhurst problems is that of deciding how long an immunity produced by tuberculin may last. So far as I know, no collection has been made of relapses in persons who may be said to have won, in the first instance, a complete recovery from an attack of pulmonary tuberculosis.

But I have said enough, too much I fear, in the way of introduction; without me, the reader will find himself at home in a distinguished company.

BACTERIOLOGY, PATHOLOGY AND RESEARCH IN
TUBERCULOSIS.

By T. J. HORDER, M.D., F.R.C.P.

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TUBERCULOSIS being the result of infection of the body by the tubercle bacillus, no account of the present position of our knowledge of this important disease can be regarded as complete that does not contain a short reference to the characters of the causal agent, the modes of its attack, the reaction of the tissues, the methods of recognizing or inferring its presence in the body, and the principles underlying our efforts at combating it by specific and by non-specific measures.

(I) THE BACILLUS OF TUBERCULOSIS. (KOCH, 1882.)

This is now regarded by most bacteriologists as a member of the *Streptothrix* group of micro-organisms; that is to say, the bacillus found in tubercular lesions is considered to be the bacillary form of an organism allied to the *Streptothricææ*. The other phases in the life history of the micro-organism are not met with in the actual disease process, but may be demonstrated in old cultures and in certain experimental lesions. This view of the essential nature of the tubercle bacillus harmonizes with our knowledge of its great power of resistance to various destructive agents; it also explains many of the tissue changes occurring in the disease, the latency seen in many cases of infection, and the chronicity of many others.

Into the peculiarities of the staining reactions of the bacillus, and the difficulty and slowness of its growth outside the body, we need not enter. The cultural difficulties are, from the practical point of view of diagnosis, compensated by the great differential value of the acid-fast, staining reaction, enabling the bacillus to be recognized easily in almost any medium. The *great resisting power* of the microbe calls for

more detailed comment. The bacillus is capable of living for several months in dried sputum, and may be cultivated, or may be made to cause disease in susceptible animals, when obtained from the dust of ordinary living rooms. The gastric juice does not destroy the bacilli, nor does the process of decomposition going on in dead tissues over a period of many weeks. The clinical importance of these facts is obvious. In contrast with these examples of resistance may be mentioned the fact that direct sunlight has a rapid lethal effect upon the micro-organism; so also has a solution of carbolic acid of strength 1:20.

It is now definitely established that differences exist between the bacillus causing the tuberculosis in human beings and in cattle, respectively. The *human type* of bacillus is less virulent to cattle than is the *bovine type*, and, though this cannot be made the subject of experiment, the bovine type is probably less virulent to man than is the human type. So far as can be judged by the observations already undertaken, about 10 per cent. of all cases of tuberculosis in man are due to infection by the bovine type of bacillus. In children, the bovine type is found, relatively, much more often; in adults, it is quite uncommon.

(2) THE SOURCES OF INFECTION AND THE MODES OF ENTRANCE OF THE BACILLI INTO THE BODY.

There are two main sources of transmission of tuberculosis—phthisical sputum and tuberculous milk. In addition to these, but probably of quite minor importance, are urine and faeces containing the bacilli, and resulting from active lesions in the urinary and alimentary tracts of diseased persons. As both these main sources of infection are easily under our control, it follows that there is no scientific difficulty in checking the spread of tuberculosis, and even stamping out the disease altogether; the difficulties are entirely political and personal. It is generally agreed that the two great routes of entry of the bacillus are *by ingestion* through the alimentary tract, and *by inhalation* through the lungs. It is also accepted as proved, by most authorities, that the former mode of entry is commoner in children, the latter in adults. The fact already mentioned, that in the

tuberculous lesions of children the bovine type of bacillus is largely found, goes to prove the truth of this statement. There is some difference of opinion on the question whether the lesions developing later in life, such as the lesions of phthisis, are due to a re-infection from without, or to auto-infection from foci developing in childhood. The trend of opinion is towards the former view. Other routes of entry are rare in comparison with the two just mentioned. Tuberculous lesions about the mouth itself are undoubtedly in most cases secondary to lesions elsewhere in the body, especially in the lungs. The same holds good for the genito-urinary tract, where the common site of primary disease is the kidney. The skin is very resistant to primary infection, and lesions that do occasionally develop here are usually extremely chronic and tend to remain localized (*verruca necrogenica*).

(3) THE FACTOR OF SUSCEPTIBILITY IN TUBERCULOUS INFECTION.

The human race is, as a whole, remarkably susceptible to infection by the tubercle bacillus. The same holds good for domestic animals, with a few exceptions. Individual differences in susceptibility are, however, very marked: the existence of tuberculous families is one of the cardinal facts of clinical medicine. It may be that a part of this familial incidence to tuberculosis is explained by similarities in the life and environment of the various individual members of the family, allowing of the same sources of infection, but this cannot explain the undoubted prevalence of tuberculosis in parents, brothers, and sisters, where the family is scattered, a circumstance commonly seen. There is a tissue susceptibility, a "favourable soil," that constitutes a potent element in the pathology of the disease. The essence of this predisposition is at present unknown to us; the solution of a considerable part of the problem of tuberculosis prevention would follow a discovery of the nature of the metabolic or other defect, underlying this difference in the tissues of the tuberculous and non-tuberculous.

(4) THE RESULTS OF INFECTION BY THE TUBERCLE BACILLUS.

The lesions produced at various parts of the body, when infection has taken place, need not be described here. The

symptoms of the disease appear to be due almost entirely to the operation of the intracellular toxins of the bacillus. In a large number of cases, and especially in phthisis, secondary infections of a pyogenic nature add symptoms of their own, not difficult to trace. The intracellular poison of the tubercle bacillus is quite virulent after the microbe has been killed, for, if dead bacilli are injected into susceptible animals, their solution by the tissues leads not only to the formation of actual tubercles, but to many of the symptoms of tuberculosis; indeed, the animal may waste and die.

Certain general results of infection by the tubercle bacillus are important in their relation to the indirect methods of diagnosis to be dealt with in a later paragraph. It is probable that the interaction of all pathogenic microbes and the tissues leads to two different sets of products—those tending to confer immunity, and those tending to establish a degree of sensitiveness, to the infecting agent. In tuberculosis, the existence of these two principles (prophylactic and anaphylactic) can be demonstrated in most cases.

(5) THE ISOLATION AND RECOGNITION OF THE BACILLUS.

In all doubtful cases of tuberculosis, this is a point of vital importance. Clinical evidence of the existence of the disease, however complete it may seem to be, must never lack the confirmation of pathological proof, whenever this is possible. ("Physical signs are the signs of conditions, not of diseases.") Seeing that the only radical proof of the existence of the disease is the demonstration of the bacillus in material derived from the patient, attention must first of all be directed to this investigation. By comparison with this demonstration, even the most definite "reaction" to one or other of the tuberculin tests, or the most strikingly positive result with the complement-fixation method, or an abnormally low opsonic index, is untrustworthy. It behoves the practitioner, therefore, to watch jealously for any material that may be available for bacteriological use, and to be quite certain that such material is not obtainable before falling back upon indirect pathological evidences (*see* § 6) to support his clinical facts.

In cases of suspected phthisis, every effort must be made to secure *sputum*, and it may be necessary to check a habit of

swallowing expectorated material. In little children, sputum, as such, is usually absent, but if vomiting occurs in association with lung disease, the vomit should be searched for fragments of sputum. In suspected disease of the kidney or urinary tract, the urine must be collected carefully and submitted to examination. Cases of *albuminuria* or of *hematuria*, in which there are not clear evidences of diffuse nephritis, should raise the question of possible tuberculous disease of the kidney. The *feces* should be scrutinized in doubtful tuberculosis of the peritoneum or bowel. If any *puncture-fluid* is obtainable—as from the pleura, the spinal theca, or a joint—this is valuable for investigation in any patient who may be suffering from tuberculosis.

The methods of dealing with these materials are not difficult, though they require thoroughness and patience when the bacilli are present in scanty numbers. The very different significance to be attached to a positive, as against a negative, result must never be lost sight of; the former affords proof of the existence of a tuberculous lesion, the latter gives at most a presumptive evidence against it.

In dealing with *sputum*, the original carbol-fuchsin method of Ziehl-Neelsen should first be tried. If the results, after carefully searching three or four films for half an hour, are negative, the sputum should be shaken up thoroughly with ten times its bulk of carbolic acid of strength 1:20, allowed to settle, the supernatant fluid run off, and films made of the residue. If the sputum is seen to be thin and watery, this method may be employed at first. If it fails, and if suspicions still exist as to the presence of phthisis, one of the recently introduced digestion methods may be used—either pepsin and hydrochloric acid, or “anti-formin.” The use of the last-named substance, consisting of a mixture of equal parts of bleaching powder solution and a 15 per cent. solution of caustic soda, is found by some workers to give excellent results. An amount of this fluid, equivalent to about one-fifth of the bulk of the sputum, is mixed with it, allowed to act for three to four hours, the mixture centrifugalized, and the deposit dealt with by one of the staining methods in ordinary use. The bacilli are, by the disintegrating action of the “anti-formin,” isolated from the albuminous

vehicle and concentrated in the deposit.

Urine is best dealt with by the carbolic acid method (v.s.), subsequent centrifugalization, and staining of the deposit. The smegma bacillus, which may be present if the specimen has not been obtained by catheter, is differentiated by allowing the stained films to remain in alcohol for 10 minutes; the tubercle bacillus is not decolourized. In *pus*, the search is much facilitated by the use of "anti-formin," and this is a useful adjunct in the examination of *feces* also. A patient suspected of tuberculosis of the bowel often suffers from diarrhœa; when this is the case, Emery's suggestion of giving sufficient opium to cause a solid stool is useful. The superficial parts of the motion are most likely to yield the bacillus, and are dealt with accordingly.

Puncture-fluids very frequently give negative results to ordinary microscopic examination, on account of the scantiness of the bacilli in them. However, the clot (if such occur), or the centrifugalized deposit, should always be searched thoroughly, as the demonstration of even a few bacilli of undoubted morphological characters is decisive. Failing this demonstration, the fluid must be used for inoculation purposes, a guinea-pig receiving a liberal amount (not less than 10 c.c. if possible).

The demonstration of tubercle bacilli in *the blood* has received a fair amount of attention of late years, but with widely different results in different hands. Reputable authorities state that bacilli can be seen in stained films in a very high percentage of all cases of tuberculosis, wherever the lesion may be. Others fail to confirm these results. There is nothing *à priori* against the possibility of such findings, seeing that we know tuberculous patients excrete bacilli in their urine even when the kidney is not itself involved, showing that the bacilli pass through the circulating blood. But it may be that the number of positive results on blood examination is directly dependent upon the number of laboratory assistants employed in searching the slides, in which case it is not likely to be high in this country, where the "technician" is not as yet an institution. Unless some simple method can be devised, which will obviate the needle-in-a-haystack conditions imposed by the examination, it is not likely to prove of practical value.

It must be remembered that the medium is a difficult one to work with, and that the sight of a single bacillus never carries utter conviction to the critical eye. Unfortunately, in general tuberculosis, in which form of the disease an examination of 5 c.c. of blood from a vein often yields several bacilli of unquestionable character, we are dealing with (at present) an incurable condition.

(6) THE INDIRECT METHODS OF DIAGNOSIS OF TUBERCULOSIS.

These depend upon the presence in the body of those sensitizing and immunizing substances referred to in section (4). The methods are to be used in any doubtful case of tuberculosis, in which (v.s.) no material is available for investigation in regard to the causal bacillus. The relative values of the methods are still being assessed; at present, they are probably in the order of their description here:—

I. *The Tuberculin Test.*—This test depends upon the fact that if once the body is infected by the tubercle bacillus, it becomes super-sensitive to the toxins of the bacillus if these are introduced into it. The test is performed in three different ways:—

i. *Koch's Test.*—This consists in the subcutaneous injection of a minute dose of "old tuberculin," or of a series of small doses (*e.g.*, 0.25, 0.5, and 1.0 mgr.) at intervals of 48 hours. A complete positive reaction includes a rise of temperature, malaise, and evidence of slight activity at the focus of infection.

ii. *Von Pirquet's Test.*—This is best employed quantitatively. It consists in rubbing a solution of tuberculin into the skin, previously lightly scarified. Three or more strengths of the solution (*e.g.*, 25, 50, and 100 per cent.) give better results than one strength only. A positive reaction results if papules and erythema are produced at the site of the vaccination.

iii. *Calmette's Test.*—This is done by introducing a drop of a one per cent. solution of tuberculin into the conjunctival sac; congestion and more or less exudate signify a positive reaction.

Of these three tuberculin tests there is little doubt that the subcutaneous (i) is the least equivocal in its results. Its great disadvantage is that it cannot be undertaken in febrile cases. It is more likely than the other two tests to demonstrate an active focus, as against a "quiescent" or "arrested" one.

2. *The Fixation of Complement Test*.—This test is analogous to the Wassermann test for syphilis. It is claimed by some workers that it is positive in over 90 per cent. of cases of tuberculosis. The difficulty seems to be that it cannot be relied upon to distinguish an active lesion from one that is not active. Seeing that old and caseous tuberculous lesions exist in such a large proportion of all persons likely to be tested, and that these old lesions still suffice to give the complement-fixation test, its value is quite doubtful unless undertaken in a quantitative manner.
3. *The Tuberculo-Opsonic Index*.—An abnormally low, or an abnormally high, opsonic index to the tubercle bacillus is considered by many authorities to be strong presumptive evidence that the person tested is tuberculous. The limits outside which this probability exists are 0.8 and 1.2. Daily variations in the index, and changes in it as the result of exercise, increase the probability that active tuberculosis is present.
4. *Cytological Evidence of Tuberculosis*.—Another, and very useful, evidence of tuberculous infection is to be obtained in cases of pleural, and, perhaps, of meningeal, exudates, by estimating the relative numbers of polymorphonuclear cells and of lymphocytes. It is found that, in pure tuberculous infections, the cell exudate is largely, and often almost entirely, lymphocytic in character. In pyogenic infections it is very largely polymorphonuclear; in mixed infections (tubercle with pyogenic infection) the cell-exudate is also of a mixed character.

(7) THE BEARING OF THESE PATHOLOGICAL CONSIDERATIONS UPON
TREATMENT, PREVENTIVE AND CURATIVE.

The efforts made towards the cure of tuberculosis, and

towards its prevention, fall into two main groups—efforts of a non-specific and of a specific kind. Non-specific methods of treatment are aimed at raising the general resistance of the patient by a variety of means, so that his tissues are able to repel more successfully the attacks of the bacillus. Specific methods of treatment are aimed at preventing the infection, or re-infection, of the body by the bacillus, and, when the body is already infected, encouraging the formation of prophylactic substances. Controlling the milk supply, so as to ensure the purity of this food, and isolation of the phthisical patient, are the two means of a specific kind indicated by pathological research in the sphere of prevention.

In specific treatment, the tissues may be educated to form useful anti-bodies by inducing auto-inoculation, or by the artificial introduction of one or other of the varieties of intracellular tuberculous toxin termed "tuberculin." Useful auto-inoculation, of an educative character, should enter into the régime of all treatment, whether carried out in sanatoria or at home. Inoculation by tuberculin injections, or vaccine treatment, is at present in too early a stage of trial to admit of generalizations as to results. It seems clear that appropriate cases of tuberculosis are much assisted in their process of cure by the administration of tuberculin. But careful selection must be made of suitable cases, and equally careful consideration must be given to questions of dosage and intervals of administration. The secret of success, both in the induction of auto-inoculation, and in vaccine therapy, is probably *careful graduation of the dose*. Both in the matter of physical exercise, and in the use of tuberculin, it is a question of dosage throughout, and "the little more, how much it is" may often be responsible for disastrous results where brilliant ones were hoped for.



THE WAYS IN WHICH TUBERCLE BACILLI ENTER AND SPREAD IN THE BODY.

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DESPITE the great and progressive diminution in the death-rate from tubercle during the last fifty years, we have still to realize that more than 10 per cent. of all the deaths in this country, and about 25 per cent. of all the deaths in children's hospitals in London, are due to tuberculous disease in one or other of its protean forms. We have reached the stage when, in regard to tuberculosis, prevention rather than cure is our true aim, and it behoves us, therefore, from time to time, to take stock of our knowledge of the sources from which the infection is derived, of the ways in which the germs gain access to the body, of the conditions which favour their development when once they have obtained entrance, and of the lines along which the disease spreads from one part to another. Only in this way can we devise intelligent measures to prevent, as far as possible, the access of bacilli to the body, and to enable it to destroy any which, in spite of all our precautions, may obtain an entry. It is important also that we should realize the extent not merely of our knowledge but likewise of our ignorance; for, notwithstanding all that we have learned during recent years, in many directions the confines of our knowledge are soon reached, and there are still points of great importance about which we are uncertain or even entirely ignorant.

We start, of course, with the assumption that tuberculous diseases can only be produced by living tubercle bacilli. Naturally, the first problem which calls for consideration is that of inheritance, and we now take a very different view of this from that which was adopted a generation or so ago. At that time, inheritance was regarded as, perhaps, the most important factor in the causation of tubercle, and almost the first question a patient was asked was, whether any of

his relations had suffered from the disease. If several members of a family had fallen victims to it, it was taken almost for granted and as inevitable that others would succumb also.

The discovery of the part played in the production of tuberculosis by the tubercle bacillus has led us, perhaps, to attach too little importance to the influence of heredity. We may acknowledge at once that, for all practical purposes, in man the specific bacilli obtain entrance to the body only after birth. We know that in cows infection does occasionally occur before birth, and the same thing is possible in the human subject—viz., that infection may take place *viâ* the placenta, being itself tuberculous, if not actually in every instance, in nearly all. Such cases, however, are so rare that we need not trouble ourselves about them.

Under the age of three months, deaths from tuberculosis are uncommon, and when they do occur the lesions found are almost always such as suggest infection after birth *viâ* the respiratory passages, often from a tuberculous mother. Thus, in one case, in which I made a post-mortem examination of a child, three months old, who had died from extensive pulmonary tuberculosis, the mother died from phthisis on the same day; but there was no reason to suppose that the disease in the child had arisen during intra-uterine life, for the lesions found pointed definitely to infection after birth, doubtless from the mother. There are some interesting cases on record of a tuberculous midwife, who was in the habit of blowing into the mouths of new-born children to inflate the lungs, and who in that way infected a considerable number of infants with tuberculous lung disease.

The question is still not finally decided whether tubercle bacilli can be transmitted to a child in the mother's milk. Whether this be so or not, the practical point to bear in mind is that, if the mother is tuberculous, the sooner after birth the child is separated from her the better. It has been recognized for a long time that a tuberculous mother should not be allowed to suckle her child. Lactation has been forbidden mainly, perhaps, for the sake of the mother, but we must recollect that the prohibition is equally in the interest of the baby; for close contact between a mother suffering

from phthisis and her child necessarily exposes the latter to very great possibilities of infection, and therefore the new-born infant should be taken away from her without delay. What undoubtedly is inherited—and to this, perhaps, at the present day too little importance is attached—is a diminished resistive power to infection by the tubercle bacillus. We ought to realize that this is probably a very real thing, but as it lies somewhat away from the present subject further reference need not now be made to it.

Coming to the chances of infection after birth, there are three varieties of tubercle bacilli from which infection may possibly occur: the human type, the bovine type, and the avian type. Infection by the avian type of bacillus is so exceptional that it does not call for further consideration. On the other hand, that man is capable of being infected by the bovine bacillus may now be considered as definitely and finally proven. Note especially two facts: the first is summed up in the following statement from the Final Report of the Royal Commission on Tuberculosis: "Both the bovine tubercle bacillus and the human tubercle bacillus are alike in that they readily produce tuberculosis in chimpanzees, monkeys, and guinea-pigs, and in the circumstance that the lesions produced in these animals are the same in distribution and structure." We cannot, of course, make the crucial experiment of inoculating the human subject with the bovine type of bacillus, but we can test those animals which are nearest akin to man—chimpanzees and monkeys—and we find that they can be inoculated quite as readily by bacilli of the bovine as by those of the human type.

The second striking fact is that bacilli, apparently of the bovine type, are found in cases of human tuberculosis, and if such bacilli are inoculated on to calves, they give rise to a generalized tuberculosis, exactly similar to that which is produced by inoculating bovine bacilli direct from bovines on to other calves; whereas if we inoculate bacilli of the human type, derived from cases of human tuberculosis, on to calves only a local lesion is produced. It follows that if bacilli, having the apparent characters of the bovine type, but found in cases of human tuberculosis, give rise, when inoculated on to calves, to lesions in all respects identical with those which

we find in calves inoculated with bacilli derived directly from bovines, then the bacilli derived from human subjects must themselves have come originally from bovines.

Lastly, in the Final Report of the Royal Commission on Tuberculosis we have this very important statement—"Of young children dying from primary abdominal tuberculosis, the fatal lesions could, in nearly half the cases, be referred to the bovine bacillus, and to that type alone. In children, too, and often also in adolescents, suffering from cervical gland tuberculosis, a large proportion of the cases examined by us could be referred to the bovine tubercle bacillus." The Commissioners also found that, out of twenty cases of lupus which they investigated, nine were due to a modified type of bovine bacillus. Altogether, it is probable that something like one-fifth of all the cases of tuberculosis in children are due to infection by the bovine type of bacillus, the cases being chiefly those of abdominal tuberculosis, of tuberculous disease of the cervical glands, and of lupus.

An interesting problem is, which of these two types of bacilli, the human and the bovine, is the more virulent to man. To this question, we cannot at present give a definite answer. It has just been stated that the Royal Commissioners found that, in chimpanzees and monkeys, the two varieties of bacilli gave rise to lesions of apparently similar character and virulence. There are, however, so many other factors to be thought of in connection with tuberculous infection, that the actual virulence of the bacilli concerned is, perhaps, a less important point than might at first be expected. We have to consider also the size of the dose, the frequency of its repetition, and the resistant power of the organism at the particular time when infection occurs.

Another very interesting problem, which still remains unsettled, is whether small doses of tubercle bacilli, either of the human or the bovine type, may produce a certain amount of protection. The Royal Commissioners investigated this question and report as follows: "By the inoculation of large doses of human tubercle bacilli, as also by vaccination with small doses of living bovine tubercle bacilli, the calf can, in many instances, be enabled to resist the inoculation at a latter period of a dose of bovine tubercle bacilli which otherwise would have set up in it severe and fatal tuberculosis." (Note,

of course, that the calf is much more susceptible to bovine than to human bacilli.) In some of the animals, however, no resistance was produced, and the number of experiments made was insufficient to enable any definite conclusions to be drawn. Obviously, this is a most important practical point, which we must try to determine in the future—whether, that is, any protection against tuberculous infection is afforded by inoculation with small doses of bacilli, either of the human or of the bovine type.

We have next to consider how the bacilli get into the body. It is possible for inoculation to occur through the skin, but this happens so rarely that, as in the case of possible intra-uterine infection, we need not trouble about it. We have to realize that in nearly all cases the bacilli enter either by inhalation or by ingestion.

First, then, as to inhalation:—this raises the question of direct infection from patients who have tuberculous lung disease. It may be regarded as proved that the ordinary expired air of such patients does not contain tubercle bacilli, but the matter is very different when they cough. In the act of coughing, and, to some extent also, in speaking, singing, and sneezing, there is projected with considerable force into the air a spray or foam containing a great number of living bacilli; so that the cough of a patient suffering from tuberculous lung disease, especially in a late stage, is a very dangerous thing indeed. The sputum, we know, contains, particularly in advanced cases, enormous numbers of bacilli, and if it is not destroyed, but allowed to dry, especially in places which are badly ventilated or to which sunlight does not obtain direct access, then these bacilli may remain alive for long periods in dust, and so may seriously contaminate the atmosphere. What holds good of sputum is, of course, equally true of tuberculous discharges from other lesions, whether in man or in animals. Undoubtedly, any discharges from tuberculous lesions, which are allowed to dry, may set free bacilli in the atmosphere, and these in time may be inhaled. Quite recently, some French observers have been examining the sweat from tuberculous patients, and they are of opinion that this too contains tubercle bacilli in considerable numbers.

Secondly, ingestion of tubercle bacilli. This must necessarily

be mainly in food. Meat is a comparatively small danger, for it consists chiefly of muscle, in which tubercle bacilli do not flourish, on account of the acid secretion to which muscular activity gives rise; even if any stray bacilli are present, they will be destroyed by cooking, although there is a possibility that they may be contained in raw meat juice.

Essentially, however, the food which is dangerous is milk. Unfortunately, an enormous number of cows in all parts of the world are tuberculous; we have no accurate figures for this country, but probably the number is not less than from 20 to 30 per cent. of all dairy cows, and in some Continental countries the proportion is even higher. The prevalence of the disease is, undoubtedly, very largely due to the unhygienic conditions under which these animals are kept, and to the absence of any precautions to prevent infection, so that the disease once started is rapidly transmitted from one to another.

It has been recognized for a long time that, so far as milk is concerned, the greatest danger is in connection with tuberculous lesions in the udders of the cows; and it is a serious thing to realize that probably nearly 2 per cent. of the dairy cows in this country are suffering from this disease, and, consequently, that their milk must contain enormous numbers of virulent bacilli. Usually in towns, we drink a mixed milk, drawn from a number of different cows, some tuberculous, others not. The result is that, in London and other large cities, something like 10 per cent. of the samples of milk, taken at random, contain tubercle bacilli. This mixing of milk from different cows means, therefore, that bacilli are present in a larger number of samples, but that they are more diluted and thus, to some extent, the danger to which they give rise is diminished.

Whilst, however, the probability of bacilli being present in milk is undoubtedly greatest when the udders are affected, it is quite certain they *may* be met with when a cow is suffering from tuberculous disease in any part of the body, especially if the intestines or genital passages are involved. The danger to adults from such infected milk is probably inconsiderable, because the amount which they consume is, as a rule, insufficient to cause any serious risk. The danger for children is much greater, partly, of course, because milk is a much more

important article in their dietary, partly also because they are more susceptible to infection at this age than in later life.

The chances of infection are undoubtedly greatest when a child or a number of children are fed on the milk of one particular cow, which, unfortunately, happens to be suffering from tuberculous udders. There are cases recorded which prove quite definitely the very real risk which exists under such circumstances, so that it is certainly unwise for a child ever to drink the milk from one cow only, unless she has been shown by the tuberculin test to be entirely free from tuberculous disease. We must remember that the danger is not confined to milk; it extends also to the many products derived from milk—cream, whey, junket, and even butter and cheese.

There is another way in which tubercle bacilli may be ingested in early life, a mode of infection to which, I think, perhaps sufficient importance has not generally been attached. All children, before beginning to walk, pass through what is commonly known as the crawling stage of life, a stage in which they crawl about on all-fours over carpets and floors, staircases and pavements. Naturally, their hands get exceedingly dirty, a fact very easy to verify, and any dirt on the hands of a small child is almost certainly transmitted to its mouth, and so to its alimentary canal. We know that tubercle bacilli have actually been found in the dirt under the finger nails of school children; how much more likely are they to be present in the dirt on the fingers of a baby crawling about a dirty room or pavement. This, I think, may help to account for the comparative frequency of abdominal tuberculosis in the second and third years of life, for we must remember that the crawling stage often lasts a few months, and in the case of rickety children may extend over a year or two.

We have next to consider the distribution of the bacilli in the body. The main entrance is either by the mouth or the nose. Having obtained entrance, they are brought at once into contact with a mucous membrane. Now, what may happen to them under these circumstances? Vast numbers are, doubtless, destroyed by the mucous membranes; but if the latter should be in an unhealthy condition, local infection may be set up. Moreover, it is undoubtedly

possible for the bacilli to pass through a mucous membrane without causing any local lesion whatsoever. Possibly they may pass directly into the blood vessels—that is a point upon which perhaps we are still not absolutely certain; the larger number enter the lymphatics and so get conveyed to the nearest lymphatic glands. Here, again, they may be destroyed; but, if a gland is in an unhealthy condition, or if the number of bacilli brought to it is overwhelming, tuberculous disease, with the familiar results, caseation and so on, may follow. There is yet a third possibility, namely, that the bacilli may pass through the glands, just as they pass through the mucous membrane, without giving rise to any mischief, and so may eventually, by these indirect channels, reach the blood stream.

In the nose, mouth, and pharynx, the bacilli rarely give rise to local lesions, but they often pass through the mucous membrane, and set up tuberculosis in the cervical glands. Fortunately, it appears that in no part of the body is tuberculous disease more likely to remain localized than it is in these glands. It has been suggested that the disease may extend from them to the apices of the lungs. The suggestion is based mainly upon the results of experiments on pigs, but it does not appear that any direct channels of communication exist in human subjects, so that we ought not too readily to draw analogies between the results of such experiments and what is likely to happen in man. Anyhow, there is no doubt that tuberculous disease of the cervical glands is more likely to occur if the pharyngeal mucous membrane is in an unhealthy condition, if the tonsils are enlarged and unhealthy, or if adenoids are present; in fact, tubercle bacilli have been found in the crypts of enlarged tonsils.

Now let us follow the bacilli down the alimentary canal. The œsophagus, the stomach, and the duodenum are rarely attacked. The germs probably pass too quickly down the œsophagus to have a chance of effecting a lodgment, whilst in the stomach tuberculous disease is prevented by the acidity of the gastric juice. Unfortunately, although this acidity is sufficient to save the stomach itself from being infected, it is often not sufficient actually to kill the bacilli,

particularly if they are protected by viscid mucus, as in sputum, and especially in young children, in whom the normal acidity of the gastric juice is less than it is in the adults.

Moreover, there is no doubt that if any catarrhal condition is present in the stomach, bacilli may readily pass into the duodenum still alive, and, when they reach an alkaline medium in the intestine, may lodge in the lymphoid tissue either of the small or of the large bowel, and there give rise to the familiar tuberculous ulceration of the intestine. From these ulcers infection frequently extends to the peritoneum, and chronic tuberculous peritonitis follows. We are very familiar with the minute tuberculous nodules so commonly seen on the peritoneal side of a tuberculous ulcer of the bowel, and which serve in a doubtful case to distinguish it from a typhoid ulcer; from these mischief may gradually spread over the whole of the peritoneum. One important reason, probably, why chronic tuberculous peritonitis only too commonly runs an unfavourable course, is that it occurs so often as a secondary result of tuberculous ulcers of the intestine, which we know seldom heal.

The mesenteric glands may become caseous, either secondarily to intestinal ulceration or, as already stated, without any visible lesion in the bowel whatsoever. From the mesenteric glands, infection may apparently spread to the broncho-tracheal glands, and so to the lungs. Thus, it is possible that bacilli taken into the intestine with food may set up chronic tuberculous disease in the lungs. We shall consider the significance of this fact directly.

Next, let us deal with tubercle bacilli which are inhaled, and with their behaviour in the respiratory passages. Fortunately, as a rule, such bacilli are caught by the ciliated epithelium which lines these passages, are returned to the larynx, and there coughed up; thus infection is prevented in the vast majority of instances. It is probable, however, that under various conditions the bacilli may escape the action of the ciliated epithelium, may get into the terminal bronchioles or the alveoli, and either set up disease there, or pass into the pulmonary lymphatic channels. The old view was that tuberculous lung disease was commonly produced in this fashion, by direct inhalation of bacilli which escape expulsion

by the ciliated epithelium.

In recent years, however, experiments made by Calmette and his pupils, at Lille, have thrown considerable doubt upon views, which at one time were received by everyone without the slightest hesitation, so much so that some observers now maintain that tuberculous lung disease is commonly due to infection *viâ* the alimentary canal. Sir William Whitla, in the Cavendish Lecture which he delivered in 1908, stated this view very strongly when he said: "In the immense majority of cases, pulmonary tuberculosis is not contracted by inhalation, but by the ingestion of bacilli or bacilliferous products which penetrate the intestinal mucosa." Similarly Dr. Cautley, in his work on *Diseases of Children*, published in 1911, writes, "Air infection probably means that the bacillus enters through the mucous membrane of the throat or alimentary tract; direct infection of the lungs is negligible."

These are very revolutionary statements; they completely and entirely upset the views which everyone implicitly accepted until very recently. The question is, are they true? They are based on an extensive series of experiments, which apparently prove that carbon particles and tubercle bacilli can enter through the alimentary canal, pass through the intestinal mucous membrane, and finally, mainly probably by lymphatic channels, reach the lungs and even the deep cervical glands; and on a converse set of experiments, which show that carbon particles and tubercle bacilli inhaled directly into the lungs do not set up pulmonary anthracosis or pulmonary tuberculosis respectively.

Despite these experiments, conclusive though they appear to be, I still think we ought not hurriedly to abandon the old views with all the important conclusions and practical deductions which would follow from so doing. In the first place, it is very difficult to believe, after all the experiments made upon animals during a number of years past—apparently showing that pulmonary tuberculosis is set up directly by inhalation—that, in all such cases, it was due to infection *viâ* the throat or the intestines, and not by the air passages; especially when we remember that, although the animals died from lung mischief, no disease was necessarily found in the intestines or in the abdominal glands.

Secondly, we know that in countries, especially Eastern

countries, where little or no milk is consumed, pulmonary tuberculosis is exceedingly common. How are we to explain its prevalence under such conditions? Thirdly, we have the very important fact which, so far as I know, has never adequately been explained by those who hold the modern view, that in most cases of chronic pulmonary tuberculosis the bacilli present are of the human type only, and very rarely indeed of the bovine variety.

Now, if tuberculous infection of the lungs occurs *via* the alimentary canal, it must be largely by food, that is, by milk, and, consequently, by bacilli of the bovine type. It follows that the resultant lung disease ought to give us bovine bacilli, but as just stated, they are found only in exceptional cases. A possible explanation would be, that, by long-continued residence in the human body, bacilli, originally of the bovine type, become transformed into those of human type; but of such a transformation we have at present no proof whatever, for, although the matter was investigated by the Royal Commissioners on Tuberculosis, they report that they found no sufficient evidence of its occurrence.

Fourthly, the experimental evidence is, after all, conflicting. Quite recently, a number of observers have found that, in guinea-pigs, carbon particles do not reach the lungs or the bronchial glands from the intestines; conversely, that pulmonary anthracosis can easily be produced by inhalation of soot-laden air, and therefore, presumably, that pulmonary tuberculosis may result from the inhalation of air containing tubercle bacilli. Furthermore, many experimenters state that a much larger dose of tubercle bacilli is necessary to secure infection through the alimentary canal than through the respiratory mucous membrane.

It is not for me to decide between these contradictory results on so important a matter, but, at any rate, the disagreement should make us hesitate a long time before we pin our faith to the more modern view. It is a curious fact that, only a few years ago, Koch was teaching that the danger of infection of human beings by bovine bacilli was practically negligible. Now we are being told that nearly all tuberculous infection of the human subject occurs *via* the alimentary canal, and that it is largely due to bovine bacilli. The moral is that we should beware of extreme views and of hasty conclusions.

Probably, it will be as unwise to act on the assumption that Calmette's conclusions are true, and that direct infection of the lungs is negligible, as experience has shown it was unwise to act upon Koch's view that bovine tubercle is not transmissible to the human subject.

We have still to explain the occurrence of tuberculous disease in the deeper parts of the body—in the bones, the joints, the kidneys, etc. About this we have much to learn. We can only assume that the bacilli attack these parts through the blood stream, and that they obtain entrance into the blood, as already suggested, from the mucous membrane of the alimentary canal or of the respiratory passages, either directly into the blood vessels or indirectly *viâ* the lymphatic channels, without necessarily giving rise to any local lesion on their way. We must recognize the very important fact that local conditions greatly favour the development of tuberculous lesions in these deep-seated parts.

First of all, there is the influence of trauma. Everyone knows how frequently tuberculous disease in the spine, in a joint, or in a testicle, follows a blow, a sprain, or an injury of some kind. Such occurrences are far too frequent to be explained by mere coincidence. There seems to be no doubt that, when the vitality of an organ or a part of the body is diminished by an injury, any bacilli, which may be circulating in the blood stream, and in time would otherwise probably have been destroyed, find a favourable soil upon which to develop. Secondly, we realize the importance of pre-existing morbid states and unhealthy conditions, not only of the bones, joints, kidneys, etc., but also of the lymphatic glands. If the organs and tissues of the body are healthy, they resist stray tubercle bacilli which may be present in the blood; if they are diseased from any cause whatsoever, such bacilli are only too likely to find a lodgement. The important practical deductions which follow from these facts are sufficiently obvious.

Lastly, we may have a general infection, caused by bacilli entering the blood stream in very large numbers. For this to occur, it is probably essential that there should be some local depôt or focus of disease, usually a softening caseous mass. A local tuberculous lesion may, doubtless, arise, as a

result of infection *viâ* the blood stream without such a softening focus; a general tuberculosis, rarely, if ever. We may compare what happens with what takes place under conditions of warfare. We hear often enough of the danger of a raid, which may lead to damage by the enemy in a certain district or local area; but this would never suffice by itself for the conquest of a large country. Such a raid may be compared with the possible results of a limited number of tubercle bacilli obtaining entrance accidentally into the circulation. If, however, the country is to be conquered, the enemy must establish a definite base or centre, from which he can operate and overspread the entire country.

This is what occurs as the necessary precursor of a general blood infection. From a caseous focus, in which softening is taking place, enormous numbers of bacilli escape into the blood stream, either directly or indirectly *viâ* the lymphatics, the resistant powers of the body are overcome, and general miliary tuberculosis follows. As a rule, especially in children, the local focus of infection is a softening lymphatic gland, either in the thorax or the abdomen. In London, it seems from post-mortem observations usually to be one of the broncho-tracheal glands. In Scottish cities, it would appear more frequently to be a mesenteric gland. The cause of this difference I will not attempt to explain. At any rate, it is important to remember that caseous bronchial, or mesenteric, glands always constitute a possible danger of general miliary tuberculosis.

Whilst, however, the internal lymphatic glands are of special importance in this connection, it must not be forgotten that a softening caseous mass in any part of the body may serve as a centre for a generalized infection. It may be tuberculous disease of a bone, a joint, the middle ear, or, occasionally, of the cervical glands; in adults, it is usually, perhaps, chronic lung disease. Sometimes, an operation upon an old caseous mass leads to the entry of a large number of bacilli directly into the blood stream, and is followed by a rapidly fatal general tuberculosis, but fortunately this is very rare.

It is a curious fact that, even when a general blood infection occurs, the stress of the disease may fall mainly upon one

particular part of the body. Although, for instance, in the majority of cases of tuberculous meningitis, miliary tubercles are found in abundance, at the post-mortem examination, in the thoracic and abdominal organs; yet, in a considerable number of instances, they are almost limited to the cerebral membranes, although the infective caseous focus is present just the same, no matter whether the tuberculosis be limited or generalized. In other cases, we find miliary tuberculosis, obviously due to blood infection, affecting the lungs and the pleura, and yet only some scattered tubercles in the abdomen and the cranial cavity. In a third class, which is by no means uncommon, we have a miliary tuberculosis, again certainly the result of a blood infection, affecting the peritoneum, although there are few, if any, tubercles in the thorax or the cranial cavity; this explains why a large number of cases of acute abdominal tuberculosis make a satisfactory recovery. Why a general blood infection should thus be localized, we cannot at present explain; but it is a very interesting fact.

What are the practical lessons we should learn from the foregoing statements, in regard to the origin and spread of tuberculous disease in man? Prevention is, of course, our final aim; for attempts at cure, whether by building costly sanatoria, by climatic treatment, or by elaborate methods with drugs or injections, are, after all, merely confessions of failure. A man who has once suffered from tuberculosis can never again be regarded as perfectly sound; he is always more likely than before to fall a victim to the disease. It follows, from what has been said, that prevention can only be attained in two ways; first, by destruction of tubercle bacilli, especially in the sputum from tuberculous patients and in the milk from tuberculous cows, and also, be it noted, by destruction, as far as possible, of discharges from all other tuberculous diseases, whether in man or in animals. Perhaps we hardly realize the millions of bacilli which must be discharged daily by a tuberculous cow; a vast number no doubt perish, but some may survive and eventually become a danger to human beings.

The second great method of prevention is to maintain at their highest possible efficiency the resistive powers of the body. It is essential to keep the mucous membranes in as thoroughly healthy a state as possible, remembering that directly catarrhal conditions occur either in the throat, the

respiratory passages, or the alimentary canal, the development of tuberculous disease is greatly favoured. Moreover, if a mucous membrane is unhealthy, its associated lymphatic glands will probably be unhealthy also, and, consequently, the second line of defence is dangerously weakened, because unquestionably healthy lymphatic glands are capable of destroying tubercle bacilli.

Lastly, if the bacilli escape destruction by the mucous membranes and lymphatic glands, and actually get into the blood, even there they may be destroyed, unless they are in overwhelming numbers, provided the system generally is in what we term a fairly resistant condition. Unquestionably, from time to time, nearly everyone is exposed to infection by tubercle bacilli, but, fortunately, in the great majority of instances, they find no particular part in an unhealthy condition, and, consequently, sooner or later, they succumb to the defensive forces of the body.

It is obvious, therefore, that, for the present, we certainly cannot afford to neglect any means of prevention whatsoever. Our final and highest ideal is, no doubt, entirely to prevent the entry of the bacilli into the body, either in air, food, or dirt ; but it is certain that, for a long time to come, this ideal is impossible of attainment, so that it is of the utmost importance to maintain the resistive mechanisms of the body in the highest possible state of perfection. By so doing, we have the additional satisfaction of knowing that we are, at the same time, diminishing the risks which attend other microbial infections. It is a high achievement to render the body more resistant to the tubercle bacillus ; it is a still grander aim to be able, at the same time and by the same precautions, to increase its immunity to all the other various pathogenic germs which are ever ready to attack it. In the moral world it is desirable, no doubt, to shield children and young adults from special dangers and temptations : but it is still more important so to train and educate them that the moral perils which they must encounter in life, if they are to be anything more than mere hot-house plants, may find no suitable soil in which to germinate, but perish like seed sown by the wayside or upon stony places ; and the laws which govern the moral and the physical worlds are identical.



THE DIAGNOSIS OF PULMONARY TUBERCULOSIS
AND THE PRINCIPLES OF ITS TREATMENT IN
THE EARLY STAGES.

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DIAGNOSIS.

THE diagnosis of pulmonary tuberculosis, when there are clearly defined symptoms, marked physical signs, and tubercle bacilli present in the expectoration, is within the capacity of any senior medical student. It is a misfortune that the disease in this stage is sometimes undiagnosed for months, because the simple routine examination required has been omitted, and symptoms only have been treated. In such cases, a correct diagnosis can always be made, provided that the medical attendant is on the alert as to the possible cause of the symptoms, and so is led to make the necessary routine examinations. Failure to make a correct diagnosis in these instances is not due to want of knowledge, but to want of alertness as to the possible cause of the symptoms, and sometimes to want of care. These causes of failure are happily becoming yearly more infrequent in this country.

The diagnosis, when physical signs are slight, and still more when they are indefinite and merely a matter of suspicion, is by contrast one of the most difficult problems in medicine. In all such cases we must weigh the evidence obtained from every possible source, the history, the symptoms, the physical signs, the results of laboratory investigations, the findings of X-ray examinations, and possibly the effects of an injection of old tuberculin for diagnostic purposes. In a number of instances repeated examinations may be necessary, and the patient may have to remain under observation for some time, before a definite opinion can be given with adequate accuracy as to the presence or absence of pulmonary tuberculosis. It should indeed be regarded as an axiom, whenever from any cause tuberculosis is suspected, that the patient should remain under close observation, until a definite answer one way or the other can be given.

The limits of space in this article will best be met by taking the above points consecutively, and dealing with the data they may supply.

History.—I do not attach much importance to a family history of tuberculosis; that is to say, I am not convinced that (apart from increased exposure to infection) the children of consumptive ancestors are more prone to the disease than the children of non-consumptive ancestors. I attach importance to a history of *exposure to infection*, whether it be from another member of the family, from a friend, or a fellow worker. My experience has led me to form the impression that, once they have contracted the disease, members of certain families have much less capacity to arrest its progress than those of others; but this fact does not appear to depend upon the presence of consumption in the ancestors.

A history of a former *pleurisy* should always attract attention. The great majority of attacks of pleurisy in young adult life are tuberculous in nature. If this fact were appreciated sufficiently, and still more if all cases of pleurisy, which cannot be shown to be non-tuberculous, were regarded as tuberculous, a large number of cases of pulmonary disease would be prevented. A case of tuberculous pleurisy, in which the dangers of the condition are clearly recognized, and adequate treatment on sanatorium lines, together with tuberculin, is given, will in later years seldom develop into the pulmonary form; in fact, in such cases, I believe that a greater degree of immunity is produced, and that these patients are less liable to consumption subsequently than the other members of the community. If, on the other hand, the character of the disease is not recognized, or if treatment is not adequately carried out, there is a very marked tendency for those, who have had an attack of tuberculous pleurisy, subsequently to develop consumption. A history of an attack of pleurisy, two to four years previous to the onset of consumption, is obtained in some twenty cases out of a hundred. The French authors have found that, in no less than 75 per cent. of the cases of tuberculous pleurisy, consumption is developed in later life.

An attack of *hæmoptysis*, it may be some years previously, is also an important fact in the history of a suspected case.

Here again, I think it is wisest to regard every case of hæmoptysis, which cannot be proved non-tuberculous, as being tuberculous and requiring treatment. Hæmorrhage from the mouth, throat, or upper air passages can usually be excluded, if sufficient pains are taken. Some cases of hæmoptysis are caused by streptococcus infection of the lungs, and have only lately been recognized. In addition, there are many other possible causes of this symptom which are dealt with in detail in the ordinary text-books. If such causes cannot be proved, hæmoptysis to the extent of a tea-spoonful should be regarded as being probably tuberculous in origin, and, if there are other suspicious points in the case, it should be treated as one of consumption, in spite of the fact that a number of such cases do not develop definite signs of disease. That some of these cases, which do not subsequently show signs of tubercle, may be tuberculous in character is probable, when we remember that in 20 per cent. or so of all cases of early lung disease there is good repair and recovery, whatever line of treatment is adopted, and even if no real treatment is given. We have no means of selecting this 20 per cent. at the time of the hæmorrhage, and it is, therefore, safer to order treatment for all.

A further important thing in the patient's previous life is a history of *repeated febrile attacks*, whether these have had no label given them, or whether they have been called "influenzal." There is a tendency to diagnose "influenza" rather too readily. A febrile attack, which may only last a week, is not infrequently due to tuberculosis, and is accompanied by symptoms closely resembling a classical attack of influenza. Another point, and one which I have gradually come to regard as one of outstanding importance, is a history that the patient, it may be for a few months only or it may be for as long as two years, has never felt really "fit," but has never regarded his symptoms as being of sufficient importance to call for a consultation with his doctor. It is best described as "*feeling tired*." The patient does not regard himself as being ill, but is readily tired and has little joy in living. This symptom is often due to toxæmia, and this is not infrequently due to the absorption of tuberculous products, but it may not be sufficiently marked to give rise to

other symptoms of the same condition, such as fever, sweating, and increased pulse rate.

Symptoms.—The chief symptoms are slight fever, increase in the pulse rate, night-sweats, a constant sense of fatigue, or the inability to take even a moderate amount of exercise without undue fatigue, dyspepsia without apparent cause, the presence of a cough, with or without expectoration, and progressive loss of weight. The presence of any of these symptoms should make us suspicious, and such further investigations as may be possible should be undertaken. For example, a proper temperature record should be kept. The temperature should be taken several times a day, and under different conditions for at least a week. It should be taken immediately before rising, immediately after the morning walk, and if raised at this time half an hour later ; at 3 p.m. ; again after an hour's rest at 6.30 p.m. ; and finally at bed time. As slight degrees of fever may be recorded by the thermometer when placed in the rectum, which are not observed when it is placed in the mouth, the rectal temperature is preferable. If the temperature at rest is above 99° , or if the temperature immediately after exertion is above $100^{\circ}\cdot4$, or fails to come to the normal within half an hour's rest after exertion, we have proof that some toxic substance is circulating in the blood. If there is other evidence suggestive of the presence of tuberculosis, this toxic substance is probably the product of tubercle bacilli. The sputum should be examined thoroughly as described in a later paragraph.

Physical Signs.—The more experience I have of pulmonary tuberculosis, the less do I rely on physical signs in the matter of diagnosis. I have no wish to underrate the value of physical signs, but I want to emphasize two things : first, that physical signs may be misleading even to the ablest clinicians ; and, secondly, that no definite physical signs may be demonstrable, although there is quite definite early mischief in the lung. Our endeavour nowadays is to diagnose the presence of this disease in a stage in which no breaking down of the lung has occurred, that is to say, our aim is to diagnose it in the stage known as "closed tuberculosis." If the disease has progressed to the stage when tubercle bacilli are present, some breaking down of lung tissue has occurred, it may be to

a very slight extent, and the disease is now of the open type. Disease of the closed type, if brought under efficient treatment at once, is a curable condition in a large percentage of cases, it may be as high as 90 per cent. ; but when there is obvious evidence of breaking down, even to the extent shown merely by the presence of tubercle bacilli, the disease is less easily cured in the majority of instances, and in any case requires a longer period of treatment.

There is no need to discuss here well-marked physical signs, such as retraction, marked loss of movement, dulness, bronchial breathing, and signs of excavation ; these and their significance are known to every fourth-year student. When the physical signs are not marked, we may have apparent slight loss of movement on one side, slight tenderness, slight loss of resonance, slight increase of voice sounds, deficient entry of air, cog-wheel respiration and the like, but none of these things are definite in so far that we can draw dogmatic conclusions from them. They can merely add to or attract our suspicion, as the case may be, and in that respect are important. To emphasize what I mean, I would say that, in my experience, definite dulness in the early stage of pulmonary tuberculosis is comparatively uncommon, and yet many are in the habit of waiting for some such sign before they will hazard a diagnosis.

The physical sign, to which I attach most importance, is the persistent presence of crepitations at the apices of the upper lobes. It is of the utmost importance that the posterior surface of the apices should be examined as thoroughly as the anterior surface, for it is in the former position that the earliest physical signs are usually to be detected. If crepitations are present, it is necessary to find out whether they are persistent. If we get the patient to breathe deeply, or to cough, and the crepitations then disappear, they may be due to a passing catarrh, or the presence of some slight degree of emphysema. If they do not disappear, and are heard at more than one examination, they may usually be taken to demonstrate the presence of a tuberculous focus, but they give us no information as to the activity or latency of that focus. If, with ordinary auscultation, no crepitations are heard, it should be our invariable rule to make the patient

cough, to see whether this act brings out a shower of crepitations at the end of the cough. These—known as post-tussic crepitations—are the most valuable physical sign we have of the presence of an early tuberculous focus, but they tell us nothing by themselves of its activity or latency.

So far, then, as physical signs go in early cases of the disease, we may have certain indefinite ones which stimulate or increase our suspicion, or we may have crepitations, and especially post-tussic crepitations, which, taken together with other things, such as fatigue and slight fever, may enable us to make a probable diagnosis.

*Laboratory Investigations.*¹—Whenever *expectoration* is present, and its cause is not well ascertained, or if there is any reason to suspect the presence of tuberculosis, it should be examined by a competent person for the presence of tubercle bacilli. It is important to remember that the early morning expectoration should be examined, for it is no uncommon thing to have a negative result returned for the presence of bacilli in the expectoration at other times, and yet to find them in the specimen obtained immediately after the night's rest. A positive result clinches the diagnosis of the presence of a definite lesion. A single negative result, as in so many other things in medicine, is of no value; a series of negative results is of more value. If the ordinary methods of examination of the expectoration are negative, then the more refined concentration methods, such as the antiformin method of Uhlenhuth and Nylander, or its modification by Loeffler, should be used; bacilli are not infrequently discovered by these, when repeated trials by ordinary methods fail. In some cases, more especially in children, the expectoration is not available, as the patient always swallows it. In these cases, the *fæces* should be examined for the presence of tubercle bacilli by means of the antiformin method.

In certain cases in which the diagnosis is obscure, the *opsonic index* in the hands of a competent and conscientious bacteriologist may afford valuable information. It should be taken, under different conditions, several times on one day: the first, after the night's rest immediately before rising; the second, after an amount of exercise sufficient in the individual case to cause a slight auto-inoculation (in some

cases this may be a walk of 15 minutes, in others it may mean several miles); and the third, after two hours' rest immediately after the exercise has ceased. If any of these indices are outside normal limits, or if there is a marked variation of the index at rest and after exercise, we have fairly definite evidence of the presence of tuberculosis, which is capable of producing an auto-inoculation and is therefore active. A negative result cannot be taken to exclude the presence of tuberculosis.

X-ray Examination. With the recent improvements in X-ray work, we are able to rely upon what is shown in the lungs under the rays. Skilled technique is, however, required, or else a positive diagnosis of the presence of tuberculosis, especially at the root of the lung, will be made when the disease is not present. Even in a doubtful case, if an X-ray examination reveals the presence of a tuberculous focus in the lung, it gives us no information as to whether it is active or latent; that is to say, it may strengthen our suspicion, but by itself cannot decide the important question whether treatment is necessary or not. A negative result does not exclude the possibility of a tuberculous lesion.

*Tuberculin for Diagnostic Purposes.*¹—The use of tuberculin for the purposes of diagnosis, whether by subcutaneous injection or according to the method of Calmette or von Pirquet, has become more general of late years. In view of the teaching of some authorities, it cannot be emphasized too strongly that a positive tuberculin reaction merely shows the presence of a tuberculous lesion; it does not by itself help us to differentiate between active and inactive tuberculosis, nor to decide whether treatment is required or not. The Calmette reaction cannot be relied upon. The von Pirquet skin reaction, even in graded doses, is seldom of service after the seventh year of childhood. The subcutaneous use of old tuberculin, or, better still, of tuberculin A.F., which gives us a strictly specific reaction and excludes anaphylactic reactions, owing to the absence of non-specific proteins, is of more service.

The use of this method, so far as pulmonary tuberculosis is concerned, should, however, be confined to those cases in which the physical signs are indefinite and circumscribed in

area, and should be avoided in cases in which fever, marked malaise, a history of recent hæmoptysis, or extensive signs are present. The patient should be kept in bed for at least 24 hours, and the temperature taken four-hourly. At the end of this time, 0·0002 c.c. of old tuberculin, or T.A.F., should be injected. If no reaction is obtained, another injection of 0·0001 should be given after 48 hours' interval. If still no reaction is obtained, the next dose should be 0·005 c.c., and if still no reaction, the maximum dose of 0·01 may be given. A positive reaction may be accompanied by a local reaction at the seat of injection; a general reaction in the form of malaise; a febrile reaction; and a focal reaction. The last is the really important thing in pulmonary tuberculosis.

Suppose we have a case with indefinite signs at one apex; if, after an injection of tuberculin, crepitations previously absent are to be heard over this area, or crepitations, previously present, become more numerous or moister, we have a focal reaction. This shows the presence of a tuberculous lesion in the lung, but it does not tell us whether it is an active or an inactive lesion. If from other observations we have come to the conclusion that the patient is suffering from toxæmia, and have excluded other causes of toxæmia, such as chronic appendicitis, the presence of fever and a focal reaction after the use of tuberculin will justify a diagnosis of the presence of a tuberculous lesion which requires treatment. It must be borne in mind, that a positive tuberculin reaction may be obtained in persons who require no treatment, and that we can only interpret the value of a tuberculin reaction when we consider it judicially together with any other circumstantial evidence before us.

Conclusions Concerning Diagnosis in the Early Stages. In the class of case with which I am dealing, we are suspicious of the presence of pulmonary tuberculosis, but we have to search for further evidence before we can give an opinion about the kind or the length of treatment required. The presence or absence of tubercle bacilli should always be determined. Even if present, they may not point in themselves to active disease, any more than persistent diphtheria bacilli show the presence of active diphtheria; but their presence, together with evidence of toxæmia or general ill-

health, is ample evidence to justify emphatic advice on the necessity of treatment. If bacilli are not present, then, apart from the opsonic index, the use of which is not always available for our patients, we have to form our diagnosis on a level-headed and common-sense view of everything in front of us. It is a problem of circumstantial evidence rather than one of direct proof.

We shall be put on the alert if there is a history of former pleurisy, hæmoptysis, or frequent febrile attacks, or if there are symptoms of general malaise, fatigue, wasting, fever, increased rate of pulse, sweating, or cough, which cannot be attributed to some other cause. When we are on the alert, we want further evidence. We obtain a temperature record under conditions of rest and exercise, and if possible an X-ray examination; we examine the chest on several occasions, and if the type of case is a suitable one, we see whether a focal reaction is given by the use of old tuberculin. If our suspicions are strengthened by these observations we are justified in making a positive diagnosis. We have to remember the great prevalence of pulmonary tuberculosis. If a man is obviously suffering from toxæmia produced by bacteria or their products, if other sources of this toxæmia can be excluded, and if all the evidence before us is compatible with a tuberculous infection, we are justified in giving a positive diagnosis until some more specific test is available for general use. If our suspicions are not strengthened, the patient should be warned that he cannot be given a clean bill of health, and that he must, in addition to following some simple treatment, be kept under observation for some time, so that if any further suspicious signs or symptoms arise, adequate treatment may be commenced at once. Here the verdict must be "not proven," and further evidence watched for.

THE PRINCIPLES OF TREATMENT.

Most modern authorities hold the view that the best form of treatment is "sanatorium treatment" combined with the prolonged use of tuberculin, and that the earlier an individual case is brought under the influence of treatment the more probable is its permanent arrest. Sanatorium treatment does

not imply that treatment should necessarily be carried out at an institution. It is merely a convenient and expressive term for the form of treatment which has been worked out at certain institutions, known as Sanatoriums. As the details of this form of treatment have become more definitely established and better known throughout our profession, it follows that the necessity for an expert has become less. As the general practitioner has grasped the essential details of the treatment, he has become more and more capable of supervising it; consequently, more and more patients can receive efficient "sanatorium treatment" in their own homes.

We must not stretch this change of opinion too far. There can be no question that, in the case of consumptives, constant skilled supervision will give the best results, and, consequently, a considerable proportion of patients will do better in an institution, with resident medical men attached, than they will at their own homes with an occasional visit from their own doctor. One important factor in the ultimate recovery of a consumptive is his character, grit, or capacity to co-operate loyally with his doctor. "You cannot cure a fool of consumption" is an old but true saying; but you are more likely to preserve a man from the effects of his folly, if someone is always available to supervise his actions from day to day and from hour to hour. For this reason, a number of patients are best placed in an institution. In the last fifteen years, I have seen too many cases in which home treatment was, from this point of view, unadvisedly attempted, not to be convinced of the truth of the above paragraph.

Another important factor in the ultimate recovery of a consumptive is his capacity to react to treatment. It is too prevalent an idea that, because a case is discovered early, it is bound to do well, and that a case with extensive and well-marked physical signs has comparatively little chance. Cases of the latter type, in which there is well-marked resistance and capacity towards repair, often do as well as cases discovered earlier. It is true that, taken in the bulk, cases diagnosed early have the best chance, but there are a certain proportion of these cases, perhaps 10 or more per cent., in which little effort towards repair is manifested. We can only determine which these are by observation, say, for a month or more. If such patients are treated at home, they cannot

obtain the same constant attention they would have at a sanatorium. It should, therefore, be the rule that, when a patient is not making adequate progress at home, he should be transferred to an efficient institution for a time to see whether improvement will not follow.

The capacity for repair also depends on the virulence of the invading bacillus and the amount of the previous lowering of resistance which has taken place. For example, English patients who contract the disease in India, Hong Kong, etc., do not, as a rule, show anything like the same rapidity of improvement as an English patient who has contracted the disease in his own country. Cases in which it is evident that the fight is going to be harder than usual, should be given the advantage of the closer attention possible in an institution.

A third important factor in the ultimate recovery of a consumptive is his accurate knowledge of his condition. It is more difficult than some of us imagine for a patient, who is feeling tolerably well, to realize the vital necessity of submitting to treatment, when he is told that he has contracted consumption. If, as a speaker once said at the opening of a sanatorium, it had been decreed by a wise Providence that a taxi-cab flag grew out of a man's forehead when he contracted the disease, he would readily be convinced. When there is no sign, such as obvious ill-health, which carries conviction to him, it is difficult for us to convince him, and this constitutes one of our hardest tasks. The human being is fond of gathering his own experience, and it is sometimes difficult for us to convince him of the reality of the lessons of our experience.

On the other hand, unless we do carry conviction to our patients, they are unlikely to put up with the restrictions which are inevitable to proper treatment. It is a disastrous thing to talk about a "weak spot" in the lung. It is our duty, in an overwhelming proportion of cases, to state his position frankly to the patient, to explain intelligibly the reasons for the treatment prescribed, and the possible penalties which may have to be faced if our advice is neglected. If we can convince our patient, we shall in all probability have won his loyal co-operation, which is half the battle; if we

fail to convince him or to get him to see the reasonableness of our advice, we cannot expect to find treatment carried out with sufficient earnestness and consistency to be of real value.

We have now to consider the essential principles underlying that form of treatment, generally known as sanatorium treatment.² In pulmonary tuberculosis, there is a constant war between the invading bacilli of Koch and, what may be termed comprehensively, the defensive forces of the body. The latter are complicated things, but our patients are wholly dependent upon them. If the defensive forces are able to respond sufficiently, we may expect eventual recovery; if there is no response, or if the response is such that the toxic effect of the bacilli or their products is not neutralized, the inflammatory process will continue, and the disease will extend. Two things follow: First, the defensive forces must be placed in such a position that they are capable of exerting their best fighting capacity; that is to say, the patients' capacity for resistance must be increased by every method in our power. Secondly, the amount of bacilli and their products absorbed into the general circulation must be limited to such an extent that their presence stimulates, but never paralyses, the defensive forces. In other words, what is now termed auto-inoculation must be regulated carefully and an effort made to bring it within the capacity of the defensive forces.

The Increase of the Patient's Resistance.—The patient should be removed from all debilitating conditions. The sanitary character of his surroundings must, therefore, be considered. He should constantly be bathed in fresh air, but exposure to wind must be avoided. As far as climate is concerned, there is no proved advantage in high altitudes. Other things being equal, it is best for the patient to undergo treatment under the climatic conditions he will have to face when treatment is at an end. Sun is an advantage; cold is better than heat, and undue moisture must be avoided. It is of the utmost importance that fatigue should be avoided; this not only wears out the defensive forces, but is usually accompanied by excessive auto-inoculation. In my experience, exertion pushed to the point of undue fatigue is the commonest cause of relapse, and is not infrequently

induced in some form of sport.

*The diet*³ should be a generous one of ordinary food, with a slight excess of fatty things, like fat, butter, potatoes, bread, milky puddings, and milk. Our aim is not to make our patient fat, but gradually to increase the weight. Care must be taken not to push the amount of food beyond the limits of the digestive capacity. The meals should be at considerable intervals to give the stomach sufficient rest. In order to ensure digestion being at its best when called upon, and to facilitate proper assimilation, the patient should rest, lying down alone and free from any occupation which involves any mental strain, for an hour before the mid-day and evening meals. He should sit quietly for a quarter of an hour after meals.

The Regulation of Auto-inoculation.—The essential thing is the quantity of bacteria and their products absorbed. An amount which stimulates the defensive forces does good; an amount which paralyses them or is beyond their capacity does harm, and sometimes so much harm that it may wipe out all the progress which has been made for weeks previously. The quantity of bacteria and their products absorbed depends upon the amount of lymph and blood passing through the diseased lung in a given time. The amount of fluid passing through the lung depends on the calls for oxygen made by movement; thus, walking exercise, a harassing cough, or vomiting will all increase the amount of fluid passing through the diseased area. Exertion determines the amount of lymph and blood passing through the lung; this decides the quantity of bacteria and their products washed out into the circulation, and this defines the task of the defensive forces. If there is evidence of excessive absorption, that is of excessive auto-inoculation, it is obvious that we must endeavour to control the dose absorbed. This we can only do by limiting movement. The regulation of rest and exercise is the fundamental thing in the treatment of tuberculosis, and, indeed, of most infective diseases. On the other hand, we must remember that the defensive forces become accustomed to a particular dose, and then, so to speak, merely mark time. When this happens, we must raise the dose gradually, by increasing the amount of exercise.

If fever or other evidence of excessive auto-inoculation

is present, the patient must rest in bed. If there is no improvement, the dose of bacteria and their products absorbed must further be limited by the rest being made *absolute*; that is, the patient must not move hand or foot, must be fed by a nurse, and in every other way protected from exertion. If the cough, for example, is harassing but is doing no good, anodynes such as codeine should be used to check it. If the cough is harassing and accompanied by much expectoration, the effect should be tried of continuous inhalation, from a Burney Yeo inhaler, of such substances as equal parts of creosote and spirits of chloroform; oil of eucalyptus; allyl sulphide, etc. If 10 to 14 days of this treatment result in no improvement, the suitability of the case for compression of the lung by nitrogen⁴ should be considered; for, in suitable cases, this method will give excellent results, as it still further diminishes the chance of a series of excessive auto-inoculations continuing.

In an afebrile case, or in one which the above methods have converted into an afebrile case, we allow gradually increasing amounts of exertion.⁴ If we remember that exercise produces the same effect as an injection of tuberculin, by producing an auto-inoculation, and that we should never produce an excessive auto-inoculation, the regulation of the amount of exercise becomes comparatively easy. At first, it may be, we can only prescribe gentle massage, and allow the patient to wash himself or to walk a few yards. Gradually, we may permit him to walk further and further until he reaches six miles a day, at the rate of $2\frac{1}{2}$ -3 miles an hour.

If at any time the patient has a rise of temperature or increased rate of pulse at rest, or the temperature immediately after exercise is over 100°·4, or there is an increase in the amount of expectoration, or the appetite fails, the amount of exercise is too great and must be diminished for a time. If the symptoms of an excessive auto-inoculation are sufficiently marked, such as the temperature at rest being above 99°, the patient must go to bed and have absolute rest until they have passed off. After an interval, a further trial of an increased amount of exertion may be made. When a patient is able to walk six miles without causing an excessive auto-inoculation, he may be allowed to use other forms of exercise,

such as riding, croquet, gardening and other forms of manual labour, etc.⁵ In each case fatigue must be avoided, and careful graduation of the amounts allowed must be made, just as in the case of walking exercise.

*Tuberculin.*⁶—This question is dealt with more fully elsewhere in this number of THE PRACTITIONER, but I may be permitted to say that, in my experience, the use of tuberculin increases the percentage of cases in which the tubercle bacilli disappear, and diminishes the number of relapses which occur subsequently to a course of treatment. Its use in febrile cases should remain in expert hands; in chronic afebrile cases, the risks to be encountered are not so formidable, and with ordinary care nothing but good should result. The vaccine should be given for at least a year, if it is to yield permanent results. The initial doses should be small. So long as no fever or other reaction is caused the size of the dose may gradually be increased; at first, at intervals of 3-5 days, and then, as larger doses are reached, at intervals of 7-10 days. Nothing but harm can result from an attempt to hurry tuberculin therapy, but it is a frequent fault. If any reaction occurs, no dose should be given until this has completely worn off, and then no increase of dose should be made until the former dose fails to produce a reaction. In my experience, the suitable maximum dose has to be found for each patient, but in most cases this dose is considerable. A blind attempt to reach a very large dose may do more harm than good.

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X-RAYS IN THE DIAGNOSIS OF LUNG DISEASE.

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[With Plates I.-VII.]

MOST of us have lived long enough to witness the claims which accompanied the introduction of various new forms of diagnosis and treatment, ruthlessly destroyed at the hands of time. But this has not been the case with Roentgen rays in their application as a diagnostic agent in the field of medicine. On the contrary, experience has not only substantiated those claims which were set up sixteen years ago, but it has exalted and glorified them, until now it may truthfully be said that that consultant who, in the diagnosis of a difficult and obscure lung condition, has not brought to his aid the service of X-rays, has failed alike in his duty to himself and to his patient.

Notwithstanding the employment in the past of the most careful precautions, it is no more than common knowledge that paracentesis, used for diagnostic purposes, has led in a certain proportion of cases—granted that proportion has been small—to the fluid in the pleural sac becoming infected by means of the needle, either through the parietal or the pulmonary pleura, and setting in motion a deplorable train of events. Where the use of X-rays is available, such an accident is unpardonable; for the presence of pleural fluid, whether serum or pus, can at once be determined and differentiated from solid pathogenic conditions in the lung by the simple process of screening the chest in front of an X-ray tube. Further, the tidal movements of the lung during inspiration and expiration mark it out from all other organs in the body as specially suitable for the employment of this method of observation. The admission of air into a lung lessens the density of the organ for the moment, and the obstruction which it offers to the passage of X-rays through it. On the other hand, the discharge of the air approximates the condition of the lung to that of a solid organ. The appearances observed on screening a chest during the successive phases of the respiratory

act vary from one of extreme lightness, down to one of comparative darkness. The lung appears to light up during inspiration, and to become darker as expiration proceeds.

He who aims at employing X-rays as a diagnostic agent in chest work must, as a preliminary measure, familiarize himself with the various shadows presented by a normal chest, in particular with those of the ribs, heart, aorta, scapulæ, spine, larger bronchi, and those more or less vertical lines which for want of a less controversial term may here be referred to as the pleuro-pericardial lines. He must further bear in mind the following broad considerations :—

1. A healthy lung and pleura offers practically no obstruction to X-rays. The corresponding appearance under X-rays is, therefore, one of dark parallel horizontal shadows corresponding to the form and shape of the ribs, separated from each other by clear spaces.
2. *Excess of air* in the lung or pleura over normal corresponds to an abnormal degree of lightness or translucency in the intercostal spaces.
3. *Diminution of air* in, or absence of air from, the lung causes the organ more or less to solidify, and so to obstruct the passage of X-rays. This condition corresponds to a deep shadow on the screen or skiagram.
4. Variations in the lung-content of air affect the position of (a) the heart; (b) the overlying ribs. The width of the intercostal spaces, which separate the latter from one another, may be increased by the pressure of excess air in the lung or pleura. On the contrary, the size of those spaces may become diminished and the ribs tend to approximate—a condition described as roof-tiling, where contraction or collapse of the lung is present.
5. Fluid in the pleural sac obstructs the rays, and is represented by a shadow whose depth varies directly with the density of the fluid.

With these facts clearly before his mind, the physician possesses in Roentgen rays an instrument of the greatest value in assisting him confidently and accurately to determine those various pathological conditions of the lungs and

PLATE I.

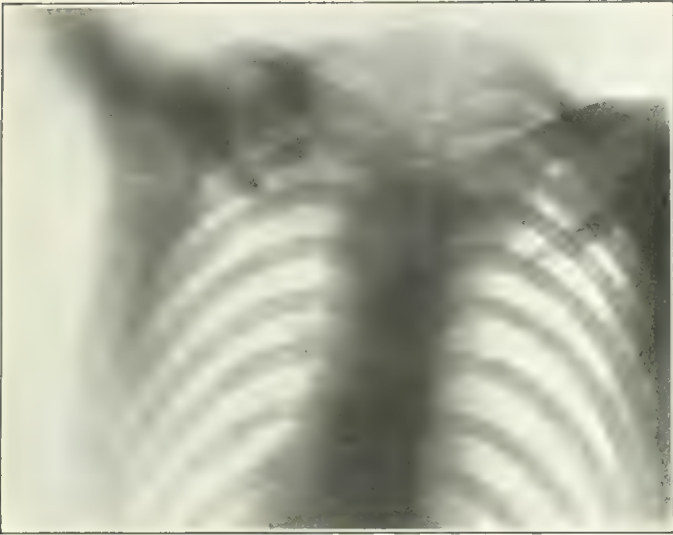


Fig. 1. — *Early pulmonary lesion (left apex).*

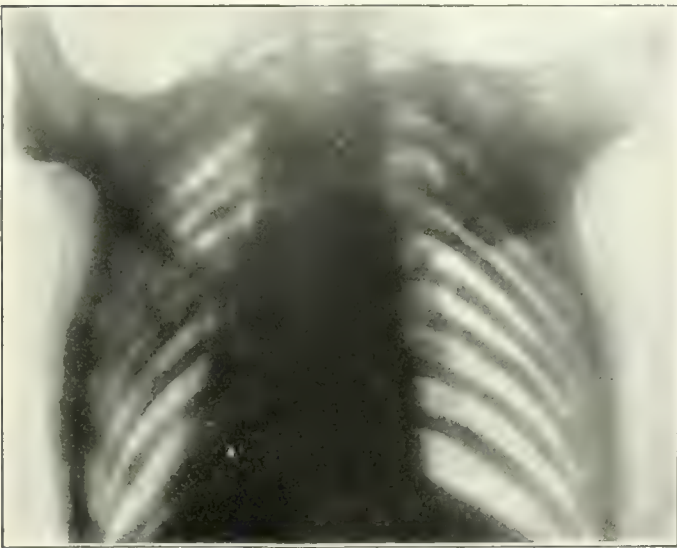


Fig. 2. — *Reflected arrangement of ribs more marked on left side.*

PLATE II.



Fig. 3 Aortic aneurysm.



Fig. 4 Bymchellitis

pleura, which are to be met with in medical practice. If, after having employed the usual methods of physical diagnosis, he is in doubt as to the existence of an early apical *pulmonary lesion*, he will invariably find on screening the case that the vertical piston movement of the diaphragm is restricted on the affected side, that the suspected apex is rather less translucent than its neighbour, and that, on deep inspiration, it fails to light up as brightly as its neighbour. The typical shadow is seen in Fig. 1. Should the disease be limited but of longer standing, and, therefore, with some associated fibrotic change, the transillumination observed on deep inspiration will be practically nil, and the presence of roof-tiling over the lesion—*vide* Fig. 2—will set at rest all doubt. In old-standing chronic cases, this roof-tiling may be extensive, and, indeed, it may affect an entire side of the chest.

The site and distribution of the lesion must be taken into consideration, before one ventures to suggest the nature of the pathological basis underlying such appearances. Whilst apical shadows for the most part suggest tubercle, a diffuse irregular shadow in the vicinity of the root of the lung suggests enlarged glands or mediastinal tumour. In differentiating glands and aortic aneurysm, screening is of great value; no one who has ever seen the even, regular, expansile movement of the shadow of an aortic aneurysm on the screen could ever again confound it with the irregular, immobile shadow, characteristic of glands or neoplasm.

It is interesting to record that calcareous patches due to atheroma in the wall of an aortic *aneurysm* have been observed by Dr. Morrision Davies (*vide* Fig. 3). When the physician discovers *bronchioliths* in the expectoration, he knows that what has at one time been an arrested and calcified lesion is in process of breaking down. Skiagraphy reveals the presence of these small calcareous deposits in the lung, and enables him to assure the patient, who has no expectoration or active constitutional symptoms, that there are good grounds for complacency (*vide* Fig. 4).

That time is well-nigh past when a physician, in a hospital with a well-equipped X-ray department at his disposal, is justified in piercing the chest wall and pleura with a trocar or needle to determine the presence or absence of fluid in

the pleural sac, to enable him to differentiate between suspected fluid and suspected consolidation. A uniform shadow distributed over the lower portion of the chest, with displacement of the heart shadow towards the opposite side of the body, and immobility of the ribs during respiration, can only be accounted for by the presence of fluid. To determine between fluid alone (serum, blood, or pus) or fluid plus air in the pleural sac may be of importance. Happily, it is easy to do so. In *fluid pleurisy*, the upper border of the shadow is not clearly defined; such as it is, it appears to possess a convex outline, which merges very gradually into a completely clear area above. The movement of the fluid is small in amount, and takes place only in the vertical direction corresponding to the piston movement of the diaphragm. But even this movement may be absent.

Very different is it in the case of *hydro- or pyo-pneumothorax*. With the patient in the upright position, in this case the upper border of the shadow forms a horizontal line which is clean cut and clearly defined. If the patient moves his body from the vertical line, the level of the shadow is not disturbed. Following the law of gravitation, it remains horizontal. This characteristic is absolutely diagnostic of the presence of fluid plus air in the pleural sac (Figs. 5 and 6). But there are other points which enable one to determine this condition. If, whilst looking at the screen, the observer lightly taps the patient's chest in the axillary region, he will observe a succession of wavelets move along the surface of the fluid from the point of impact to the border of the heart and return again. When this imparted movement has been allowed to die down he will then find the wavelets have been supplanted by a regular rhythmical movement at the surface of the fluid synchronizing with the pulsations of the heart.

Lastly, there is to be observed the vertical motion of the shadow as a whole caused by the piston movement of the diaphragm, already alluded to in dealing with fluid pleurisy. Of these movements, only the last-named is common to cases of hydro- or pyo-pneumothorax and pleurisy. Obviously, if a basal shadow should be caused by an intra-pulmonary consolidation, such as lobar pneumonia or by thickening of the

PLATE III.



Fig. 5.—*Left-sided hydro-pneumothorax.*



Fig. 6.—*Left-sided hydro-pneumothorax, taken with X-ray tilted to demonstrate presence of fluid.*

PLATE IV.

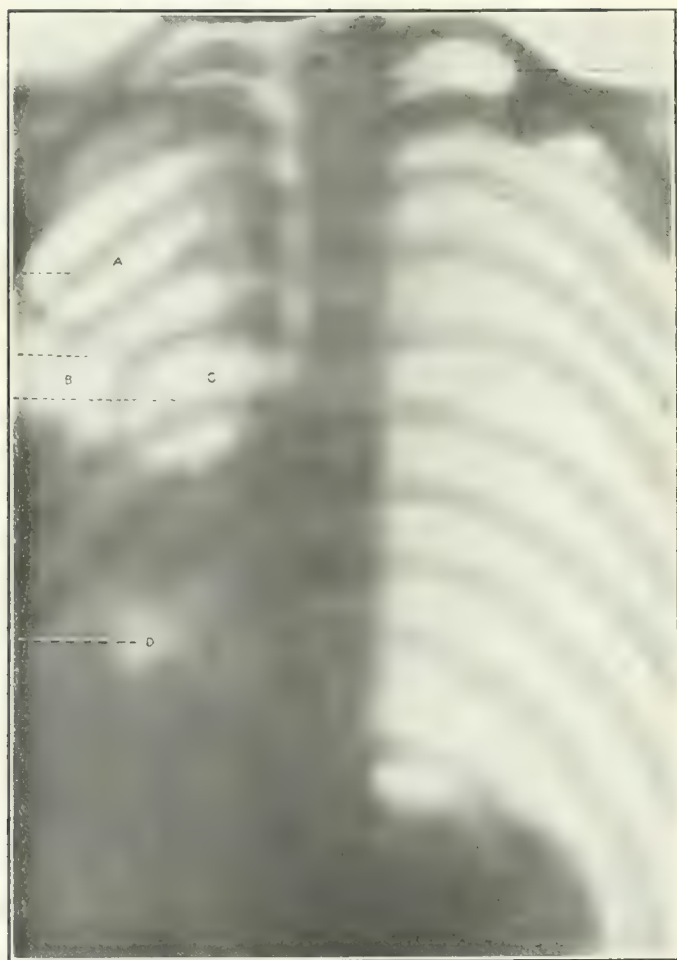


Fig. 7—*Four cavities in the lung.*

PLATE V.

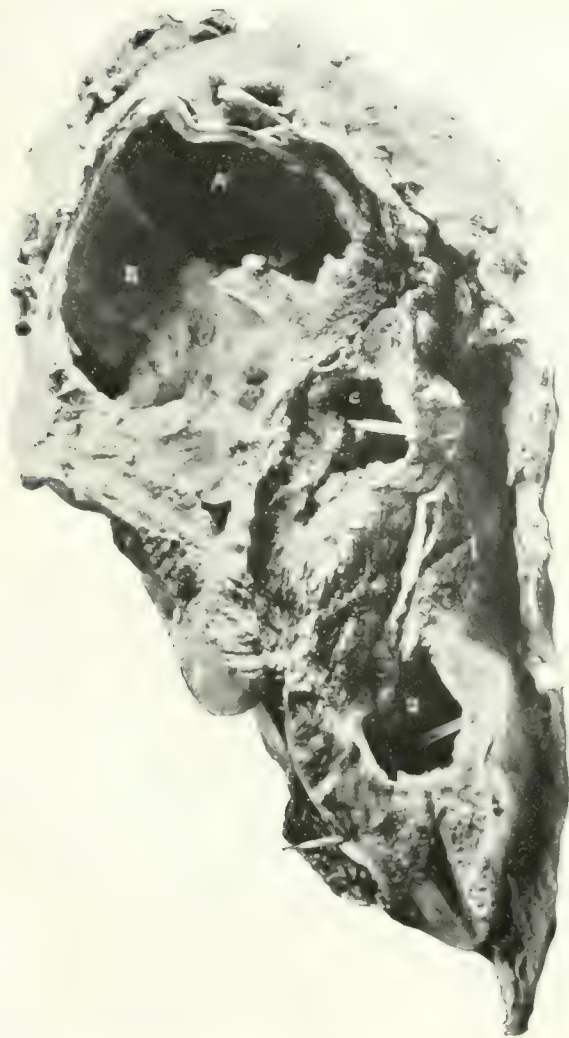


Fig. 8.- Photograph of a section of left lung from which Fig. 7 was taken during life.

PLATE VI.



Fig. 9.—Left-sided pneumothorax.

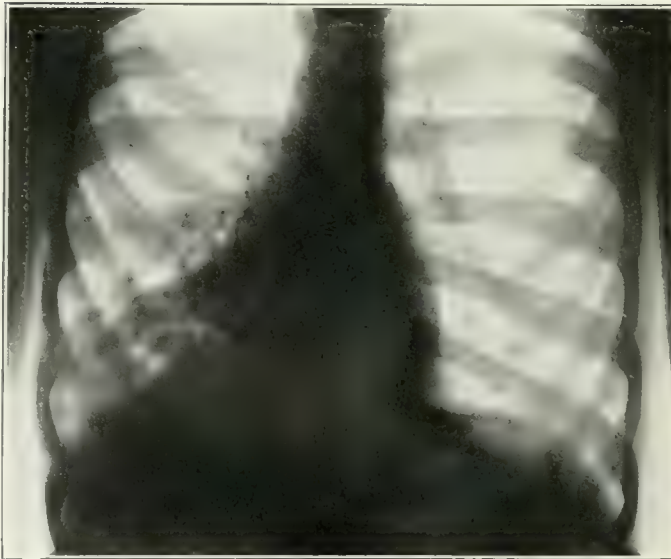


Fig. 10.—Pneumonic tasis

basal pleura, none of these movements would be observable. Dr. Morriston Davies, in this connection, has drawn attention to the fact that in cases of lobar pneumonia he has observed that the heart is invariably displaced towards the consolidated patch, in this respect furnishing further valuable evidence in the differential diagnosis between fluid and pneumonic shadows.

The presence of *cavity formation* depends for its recognition by X-rays upon those principles already enumerated, namely, that whilst consolidation in lung tissue gives rise to the presence of shadow, the existence of excess of air is recognized by an abnormally light area on the screen and skiagram. Thus, an acute breaking-down area with diffuse excavation will reveal itself by small scattered light patches in the field under consideration. On the other hand, an old chronic thick-walled cavity will appear as a dense dark ring enclosing a bright clear space.

It is not often that the X-ray observer in lung work has an opportunity of confirming the accuracy of his conclusions in the post-mortem room. Indeed, owing to the disappearance of air from the lung at death, there are relatively few conditions which can be confirmed in this way. Happily, cavity is not one of those. In Fig. 7, the reader will see a skiagram of a chest taken during life by means of which four cavities were identified. Fig. 8 is a photograph of a section of the lung taken post-mortem, showing these four cavities present. Although the skiagram and confirmatory photograph of this case have been published on a previous occasion,¹ the experience is so unusual and so striking that the writer thinks no apology necessary for reproducing them here.

Air in the pleura has already been alluded to in describing hydro-pneumothorax. Air alone in the pleural sac (*pneumothorax*) to the X-rays presents very characteristic and very easily recognized features; in Fig. 9, these are well shown. By the sudden entrance of air into the left pleural cavity the heart has been forcibly displaced, and it is shown in the extreme right side of the chest. Huddled up close to the left border of the heart, is the completely collapsed left lung, revealed as a small mottled mass. The abnormal air in the pleura has taxed the available space in the chest to its utmost,

¹ Extra Number of THE PRACTITIONER—"X-Rays in Diagnosis," 1909.

and the distension is revealed by the obvious increase in the intercostal spaces, compared with those on the other side. The skiagraphic appearance presented by pneumothorax in some respects resembles that produced by emphysema; but the existence of cardiac displacement and accompanying collapsed lung should enable one to avoid error in arriving at a diagnosis.

The diagnosis of *bronchiectasis* is so simple by other methods, that X-rays are rarely employed in this connection. Still, when the condition has become well established, the fibrous changes in the structure of the lung, and the dilatation of the bronchi lend themselves readily to demonstration by this means. Fig. 10 is a skiagram of such a case. Several stellated dilated bronchi are well shown. Fig. 11 is from a case of *secondary sarcoma*.

Fig. 12 is believed to be that of a case of *diaphragmatic hernia*; but, as the diagnosis of this rare condition was not confirmed, either in the surgical theatre or the post-mortem room, the evidence is not quite conclusive.

There is probably no more serviceable use to which X-rays are applied in chest work than to cases of suspected *neoplasm*. *Hydatids* produce a very characteristic appearance.

In conclusion, I wish gratefully to acknowledge the kindness of Dr. Morrison Davies, to whom I am greatly indebted for supplying a number of the most valuable skiagrams used to illustrate this article.



PLATE VII.

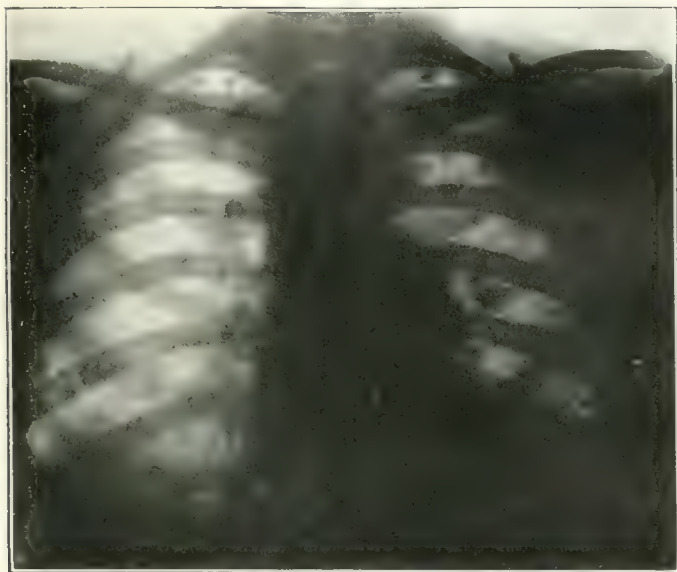


Fig. 11.—*Secondary sarcoma.*



Fig. 12.—*Diaphragmatic hernia.*

THE GENERAL TREATMENT OF PULMONARY TUBERCULOSIS.

By SIR RICHARD DOUGLAS POWELL, BART., K.C.V.O., M.D., LL.D.

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PROPHYLACTIC measures in the treatment of pulmonary tuberculosis are governed by ætiological considerations. We know that the disease is caused by the reception of the tubercle bacillus. There is, to my mind, after long and careful observation and consideration of the views of others, no room for doubt that the infection is a distributed one rather than a person-to-person contagion; that is to say, the bacilli, mostly derived from human expectoration, become deposited and mingled with dust in all kinds of dirty places, and so are inhaled with the air and ingested with contaminated foods and drinks. This is the view that practically dominates the treatment most in vogue to-day, for no one could sincerely hold the more directly contagionist view and, at the same time advocate the aggregate treatment of patients in sanatoria.

So much for the seed of the tubercle; now, for the soil in which it may be cultivated. There can be little doubt that tubercle originates in a saprophytic fungus of the streptothrix group, which has long been inured to the conditions of a human (amongst other hosts) parasite within the range of temperature of the human blood and tissues, and that, under the conditions there found, it grows, flourishes, and produces its destructive effects.*

But there is a protective influence in the serum of the blood, which is, perhaps, mainly dependent upon the leucocytes and the secretions they yield to it. This resistance to tuberculous invasion is greater in some persons than in others. It is definitely lessened in those descended from a tuberculous stock; it is again definitely lowered by conditions of depressed

* This question, amongst others touched upon in this article, is fully discussed, and the literature recorded upon which the views expressed are based, in Chapter XXVII. on the "Etiology of Pulmonary Tuberculosis," in the last edition (with Dr. Hartley) of my work on *Diseases of the Lungs, etc.*, 1911.

health from certain chronic diseases, from evil habits, and from bad sanitation. To all these conditions there is super-added, it is true, a tendency to concentration of infectiousness in surroundings, but an impartial survey of the whole subject renders it quite certain, that each of the contributory causes spoken of—heredity,¹ depressed health from chronic diseases, and evil habits—is real and operative in producing increased vulnerability to an infection so widely distributed as to be practically accessible to all persons.

We must not wholly forget, on the other hand, the influence of a certain degree of acquired racial immunity due to the selective removal, through the centuries of civilization, of the least resistant persons and families. In a relatively new community of persons, who have formerly led more or less nomadic lives and have never before been exposed to infection, the tuberculous virus will spread like fire through the stubble.

The tuberculous problem, then, from a prophylactic point of view must be handled with firmness, clear insight, and freedom from panic. We have, on the one hand, to fortify natural resistance, and, on the other, to prevent and cleanse away any accumulations of distributed poison, and to promote cleanliness of personal habits amongst the people. All measures tending to improvement of dwellings, to more accessibility to sun and air, lessened crowding of tenements, better food and clothing, and increased cleanliness in and about houses, are measures against the prevalence of tubercle. Not only houses but public places of resort, public vehicles, and stations, require to be kept as clean and as free from dust as possible; dusty factories and occupations require special care. The personal habits of the people, in this country at least, are becoming more cleanly; spitting in public places is now forbidden, and those who are the subjects of tuberculous discharges are, or should be, cautioned not to contaminate their surroundings.

Nor must it be forgotten that, amongst young children, a certain amount of tuberculosis, especially of glands and

¹ For the latest word on heredity, see "Tuberculous Heredity and Environment," Eugenics Laboratory Lecture, series VIII., by Karl Pearson, F.R.S., Galton Professor of Eugenics, University of London.

bones, is produced by the ingestion of milk from tuberculous cows, containing the bovine bacillus. It is the business of the Local Government Board and its district representatives to guard the public against this source of infection; a duty for which they are endowed with ample powers—powers, however, which are by no means always efficiently exercised. It is far more common for milk originally sound to become secondarily contaminated with human tubercle through dirty collection or storage.

The value of the dispensary system consists in the ascertainment of the conditions under which tuberculosis has arisen, and the amendment of such conditions for the individual or family. I would gravely question the propriety and safety of using the tuberculin test at all freely for doubtful cases. A person or child may be quite well, and yet have a centre of inert tubercle within him. A large percentage of the population at the present time would react to an efficient dose of tuberculin. But it is not wise to raise the devil, in order to reduce him to harmless inaction afterwards; it is better to leave him to his innocent slumber, and amend circumstances favourable to his dire awakening.

The discovery of the specific cause of the disease has given precision and insight to prophylaxis, especially in pointing to the necessity of properly collecting and destroying tuberculous discharges. But, with this important reservation, it can truly be said that the decline in the tuberculosis mortality of the last 60 years has been a steady one, dependent mainly upon improvement in general hygiene, increased well-being, and cleanliness. It is very doubtful if this decline has been influenced further by any special precautions against the recognized organism, except in those districts and countries in which such precautions have incidentally involved the more strenuous pursuit of hygienic measures, which had previously been neglected.

In speaking of the principles which govern treatment in tuberculosis, we may divide the cases that present themselves, primarily, into those that are incipient, and those which are chronic or advanced. Regarded from a public point of view, for instance, under the arrangements for the treatment of the disease contemplated by the Insurance Act, this primary

division is of great importance. In such a practical sense, the incipient cases would include the new cases which arise annually, and for which the full and rigorous application of the sanatorium benefit would most hopefully be exercised. The chronic and advanced cases would be included in the current tuberculous population, out of which the chronic cases would benefit by temporary sojourn in sanatoria during their acute phases and for educational purposes, to teach them how best to care for themselves, and how to safeguard against the distribution of infection. For the advanced cases amongst the poor, the best available arrangements should be made for their help and comfort in suitably modified wings of hospitals, sick asylums, unions, or in their own homes, without too close an observance of the counsel of perfection. They must be treated under the best conditions available for each individual, and instructed and encouraged in cleanliness and self-discipline by nurses and visitors under medical direction.

Amongst the well-to-do, the treatment of such chronic and advanced cases can best be carried out, with all practicable efficiency, at their own homes, with occasional intervals of hospital and sanatorium treatment. With a current population including some two or three hundred thousand cases of chronic and advanced tuberculosis, it is impracticable to attempt to do more than this. The afflicted have their claims upon humanity for merciful consideration, and they have their rights as citizens to personal freedom of choice in treatment. The incidence of fresh cases, still amounting to some thirty to fifty thousand, is gradually being lessened by the general prophylactic measures already spoken of. By more stringent sanatorium methods of treatment a large proportion of permanent cures may be hoped for, thus diminishing the recruits for the advanced stages, which are, in turn, gradually depleted by the yearly mortality. By patient and steadfast action on these lines the prevalence of tuberculosis will, in a generation or two, be diminished sufficiently to render treatment and further diminution a comparatively easy matter.

The first and main requirement in the treatment of consumption is a pure air. In cases of pulmonary delicacy, and even of incipient disease, removal from urban conditions to an open sea, moorland, or mountain-air life will, in most

instances, restore health. Youths under conditions of rapid growth and development with, perhaps, an hereditary impaired resistance, frequently become delicate and on the verge of active disease towards the end of the school period, and can only be saved for a healthy after-life by devoting a few months, before college or business commences, to a complete and invigorating change of the kind alluded to.

When symptoms of active disease present themselves, such as raised temperature, hectic phenomena, tuberculous sputum, and characteristic physical signs, however slight, transference to fresh air conditions must be combined with more or less complete rest, careful medical and nursing observation and treatment; in fact, the patient must be put under the sanatorium régime. This does not necessarily mean removal to a sanatorium. In exceptional cases, the treatment may be carried out satisfactorily at home; in other cases, at suitably chosen health resorts. But for the great proportion of urban populations the home conditions, even of the well-to-do, will not admit of efficient treatment, and the only possible plan promising success is for such patients to go into a sanatorium. Such, however, is the prejudice, that has been raised against sanatoria by the unwarranted dread of personal contagion, that it is often difficult and sometimes impossible to induce patients to face the supposed danger, in addition to the natural depression of leaving home for such an institution. When there, this depression is often soon overcome, as the patient is astonished at the healthy appearance of those with whom he is associated, and rises to the cheerful and hopeful spirit that prevails in well-managed sanatoria. The details of institutional treatment will be described elsewhere.

It is a matter of some importance, where such choice is possible, to select the locality and institution best adapted for the particular case in question, whether marine or inland, mountain or plain, in the home country or abroad. It must be mentioned that the superiority of institutional over other, more free but reasonably hygienic, methods of treatment of tuberculosis has, of late, been questioned. This has partly been due to a reaction of disappointment, that necessarily ensued upon the reckless manner in which sana-

toria were boomed in the public press, as effecting certain cures in all cases. All physicians of long experience are cognizant of some of their most enduringly successful cases of recovery having never undergone the sanatorium régime. Such patients have, however, been able to command the best conditions of life, and to be guided by skilled advice. Even with the majority of such cases, the discipline and education of a few months' sojourn at a well-managed sanatorium are of great value. With the great bulk of the professional, office, and labouring classes, there can be no doubt that institutional treatment affords the best chance of arrest or recovery.

In the handling of individual cases, we are guided by four initial considerations, based upon the temperature range and all that is implied by it:—

Firstly. There are cases and phases of continued pyrexia, for which conditions of treatment under absolute rest are to be observed.

Secondly. Cases of remittent or intermittent pyrexia, for which decided but varied degrees of rest are still necessary, with intervals of mild and carefully regulated exercise.

Thirdly. Apyrexial cases, in which graduated exercises, climatic change, and the like are indicated.

Fourthly. Cases of advanced and inevitably progressing disease with various complications, for the greater comfort and relief of which all the resources of medicine, hygienic management, and nursing are required. It is when cure or arrest are recognized as no longer possible that the aid of medicine is most beneficent. In the failure of this recognition of our limitations, the appropriate aid of medicine is often set aside, and the strength of the patient and the resources of his friends are wasted in the vain pursuit of results which are incapable of achievement.

The details of treatment of the different stages and degrees of pulmonary tuberculosis have been allotted to other writers. It only remains for me, therefore, to touch upon a few of the principles upon which, generally speaking, they may be regarded as founded. One—perhaps the first—object of treatment is to endeavour to fortify the constitutional resistance (if I may still use so old-fashioned a term) to the inroads of

the parasite. All hygienic and climatic measures are to this end. Such tonic remedies as may be suitable and such peptic aids as may be utilized would have this object in view. Phagocytic excitation and serum resistance have, of late years, been called in aid to secure for the patient immunity to fresh attacks, and to enfeeble and, it may be, remove the parasites. Such are the considerations underlying the use of tuberculins. It must be borne in mind that increased resistance and phagocytic activity are probably the intimate factors of recovery, which all treatment, hygienic and other, when successful, brings about.

It is very difficult to adopt a completely judicial view of the usefulness of tuberculins in tuberculosis amid the chaos of opinion that prevails, varying from enthusiastic acceptance of their almost infallible curative influence to utter scepticism of their possessing any value at all. That they are of value in suitable cases I have no doubt, and it seems clear that the auto-tuberculinization of patients, by increasing the current of blood through focal centres of disease, can be secured by judiciously regulated exercises, and has a beneficent effect in raising the opsonic index and in stimulating phagocytic action. Quite similarly is explained the disastrous effects of injudicious exercise, on those who are already febrile through an excessive absorption of toxins from extensive centres of activity. Herein lies the rationale of the employment of this method of treatment.

In cases of early disease or of later quiescence, in which there is no activity and yet the case threatens or its recovery hangs fire, the opsonic index on several examinations may prove depressed, and then the administration of tuberculin in sufficient doses to cause a moderate reaction, shown by a temporary rise of temperature, may be used, and repeated at intervals calculated gradually to raise the index to the normal. Should the index be already normal the use of tuberculin is not indicated. In many cases, however, the opsonic index cannot be obtained, either from inaccessibility to laboratories or on grounds of expense. In such, an approximately low temperature during quietude, readily rising under exercise or fatigue, may be accepted as an indication for trying the remedy, commencing with very small doses

and noting the degree of reaction both general and local.

In persons under sanatorium observation, perhaps, the same end can better be accomplished—and immunity has been acquired from all time unwittingly by the haphazard employment of the same means—by the adoption of exercises so regulated as to produce no more than a temporary and slight rise of temperature. This is the method of autogenous tuberculin administration just spoken of.

In active disease, the index is often raised above the normal by an intensity of reaction, or depressed by the paralysing influence of too abundant toxins. In such cases, to administer tuberculin is but to add fuel to the fire, and can serve at best no useful purpose. In the first days of tuberculin, I saw some cases that convinced me that the remedy sometimes proves useful by hastening the suppurative removal of tuberculous centres, but the risk of rapid disorganization of the lungs was too great, and the devitalization and collapse, even, of the patient were too serious for the treatment to be continued. In the first degree of infinitesimal administration, tuberculin probably does no harm, and some good may follow its use, such as might be effected by some other forms of psychological influence.

I have already expressed my views of the use of tuberculin for diagnosis and for treatment, apart from other more rational measures. I have pointed out the danger of raising a tumult in order to quell it, and how far wiser it is to amend the conditions that may lead to the occurrence of trouble. Statistics, more rigid and better scrutinized than any that have yet appeared, must be forthcoming before the general tuberculin dispensary treatment of tuberculosis can find justification.

The second principle of treatment is to secure rest to the lung during activity of disease. This object is obtained, as far as possible, by resting the patient, absolutely in some cases, at definite intervals and for definite times in others. Sedative cough mixtures are of value, especially in those cases in which incessant, violent, or fruitless cough is present, the object being to lessen the rending effects of cough upon the lungs, and to limit such efforts to the times when there is expectoration to be removed. Perhaps in no case is the influence of rest better exemplified than in the relief afforded in early laryngeal

tuberculosis by a prolonged period of silence.

In other cases, again, in which arrest of activity has been acquired, judicious exercises, graduated hill walking, and elevated health resorts are indicated to promote pulmonary function and compensatory development of healthy lung.

A third principle is to supplement the measures in aid of constitutional and specific resistance to the bacillary invasion by attacking other or secondary organisms, thereby lessening the vital activity of the bacillus primarily concerned. Much of the destructive changes in phthisis is due to inflammatory action, in which other organisms beside the tubercle bacillus take part; and, not infrequently, such organisms, streptococcal, pneumococcal, staphylococcal and others, take a prominent part in the production of both local destruction and constitutional symptoms. Appropriate vaccines have been suggested, and are sometimes used, to combat this associated microbic activity. Their value in these cases is a matter of controversy, and will no doubt be discussed later on. Certain drugs, notably of the creosote class, have much been used for this purpose, and were originally introduced with the view of directly destroying, or at least checking, the activity of the tubercle bacillus itself. They have fallen into some discredit lately. In my experience, they are, however, of decided supplementary value, especially in chronic cases with excessive secretion from cavities and bronchi.

The intravenous use of antiseptics has also been advocated, and is still sometimes employed, on grounds the rationale of which it is difficult to perceive. Antiseptic inhalations are also still much employed, and are useful when the upper air passages are concerned. As regards the deeper parts of the lungs, however, it may be remembered that inhaled vapours are conveyed with relative vigour to all the most healthy parts of the lung and with relative and increasing feebleness to all diseased portions.

Yet another principle of treatment is involved in feeding the patient; the old principle of starving a fever being here quite at fault, for the patient must be fed steadily through the pyrexial periods, often much against his inclination. Much ingenuity, nursing tact, and firmness must be exercised in this regard, and it may be borne in mind that, under

conditions of complete rest for periods before and after meals, febrile tuberculous patients can digest and absorb much larger quantities of food than otherwise.

The object of the dietary is to bring the patient's greatly reduced weight up to that normal for his build and height. If this can be attained, it is all to his advantage. But a caution is here to be observed, which is, that we have to do with a person deprived, more or less, of his respiratory function and with a measure of diminished circulatory capacity through the lungs. His body-weight, therefore, cannot with advantage be carried beyond that with the normal metabolism of which his impaired respiratory function can deal, and his blood-volume must not exceed that which can, without undue stress, be transmitted through the restricted vessel capacity. In successful cases, it will be observed that the healthy lung, or healthy parts of the affected lung, will take on greatly enhanced respiratory function, equal in moderate cases to coping with the full body-weight and blood-volume normal to the individual. But not infrequently it may be observed, and it was more frequent in the super-feeding and prolonged rest treatment in vogue some years ago, that the patient becomes unduly bulky, breathless, and plethoric and shows symptoms of dyspepsia, whilst hæmoptysis or some acute gastric or intestinal trouble will rapidly reduce him, perhaps, to a worse condition than before.

Finally, I wish to remark that neither the urban and indoor professional man, clerk, or factory worker, nor the dweller in other insanitary places, can return, after successful treatment, to the conditions under which he primarily became ill, without facing the great probability of a return of his malady. I am aware that it is contended that patients of narrow means, and only one method of making a living, do better to return to that method as the readiest course, involving least anxiety and privation. This may be accepted as a *pis aller*, and in practice one has known many instances of men in professional and commercial classes who, by amending the conditions of their work and looking to the hygiene of their homes, have returned to their callings with considerable success. The principle, nevertheless, remains true, and should not be compromised, except under conditions of necessity.

SANATORIUM TREATMENT AND THE AFTER-CARE OF CASES OF PULMONARY TUBERCULOSIS.

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A PERSISTENT attempt is being made in many quarters to prove that sanatorium treatment is of no value. The arguments adduced show a complete misapprehension of the scope and mode of action of such treatment, of the relation which it bears to other curative agencies, and a disregard of the nature and causes of pulmonary tuberculosis. Such arguments would not be possible if the critics had a personal knowledge of sanatorium life, if every so-called sanatorium did its work properly, or if, in statistical statements, like were always compared with like, and the constitutional condition taken into account as well as the local. As far as I am aware none of the critics have ever been in charge of a sanatorium; and it is to be feared that they must have happened on some institutions which were not run on the best lines. Owing to the great variability of the disease, and the great differences in efficiency and methods in the existing sanatoria, it is not surprising that wrong conclusions should be drawn by those without an intimate knowledge of the principles involved, although such misapprehension unfortunately tends to discredit good and bad sanatoria alike.

COLLECTIVE SPECIALIZED TREATMENT.

Sanatoria are justified in exactly the same way as are hospitals and schools. In each case, the conditions are arranged to favour the work to be done; by treating numbers together a reduction in cost is effected; and the supervision is placed in the hands of a specialist.

Sanatorium treatment at its best represents the sum of what has been learnt during the last 56 years in the treatment of pulmonary tuberculosis—climate, a sheltered site, hyperaëration by day and night, dust-free rooms, the absence of re-infection, suitable food, drugs, inhalations, vaccines, tuber-

culins, and, above all, the regulation of rest and exercise according to temperature.

There is no reliable alternative method in treating a well-marked case, and the choice lies between such treatment under continuous medical supervision and thoroughly suitable hygienic conditions, and a more or less imperfect imitation elsewhere with only occasional medical supervision.

THE NEED OF CONTINUOUS SUPERVISION.

Pulmonary tuberculosis depends not only on infection—for many of the infected never ail—but also on reduced constitutional resistance, due sometimes to acute illnesses or accidents, or to inheritance, but more often to mistaken habits and unfavourable conditions of life. Those who have attempted to change such habits and conditions in the face of domestic prejudice and opposition, and in spite of inadequate resources, will realize how much easier it is to effect in a sanatorium under continuous medical supervision than in places where the domestic head is uninstructed and absorbed in cares of a different nature. The superiority of continuous medical supervision is accepted without question in Germany, where there are comparatively few sanatoria without a resident medical officer. Even nurse-rule is much inferior to medical management, as one might expect; moreover, the supply of suitably gifted and suitably trained nurses is grievously inadequate. The need of continuous medical supervision is especially felt in carrying out graduated exercise. Judgment is required in prescribing the amount of exercise, and the patient must be seen personally to estimate the effect. There are doubtless stages when the supervision need not be so close; but during the earliest and the latest stages of graduated exercise a careful watch is imperative. As in so many other things, it is the beginning and the end that call for most care.

In a well-conducted sanatorium, the physician is present at the chief meals, and also visits the patients at least three times a day. Although some of these visits are not always necessary, it is unsafe to reduce their number as a general rule. During febrile stages, however, if a competent nurse is in charge of the case, daily visits will often be sufficient: the

patient being at rest, he is less likely to come to harm.

TIME REQUIRED.

So long as fever lasts, the object of modern treatment is to reduce auto-inoculation, and to increase the formation of antibodies. This takes a variable time, so that no general estimate can be given. During the next stages, the object is to form useful habits, to give time for healing of damaged parts, and gradually to increase the exercise while avoiding excessive febrile reactions. The time required is again very variable, but may be put at three months in cases with strictly limited lesions (unilateral mischief not extending below the second rib anteriorly, and the scapular spine behind), and but slight constitutional disturbance. Cases with more extensive mischief or with marked constitutional disturbance, will require much more time, possibly a twelvemonth or more, according to the degree of constitutional impairment at the start. Habits are not formed in a few weeks, and if the effort to form such habits is relaxed too soon, the good is soon undone. One sees this even in medical men, who come as patients to a sanatorium. Healing, too, of necessity takes time, and until it is accomplished there is the danger of mixed infection to reckon with.

When auto-inoculation no longer results from exercise, the time has come for graduated work, which may be done in a sanatorium or a health colony, but should in every case be under medical direction. The object is to harden the muscles, and make the patient not only well, but robust and capable of hard work. The place of graduated work is to some extent taken abroad by mountain climbing. But this does not develop the muscles of the arms, and has fewer economic advantages for the working classes.

Taking all these stages together—the febrile, the stage of healing, and the stage of graduated work—twelve months are not too much for the average early case of pulmonary tuberculous illness; and this is what is arranged at one of the best sanatoria in America. More, of course, is necessary for cases with extensive lesions or profound constitutional disturbance.

THE SANATORIUM AND THE HOME DOCTOR.

In spite of tuberculin and all other known aids, recovery

is very slow from pulmonary tuberculous illness. If the whole of the time is spent in a sanatorium, the family doctor loses touch of his patient. If, on the other hand, the more difficult stages of treatment are attempted under improvised conditions, and with discontinuous supervision, the patient is sure to suffer.

It would be a great help if every general practitioner invariably spent at least three months in a sanatorium; for, in that case, he would know something of the principles and methods of modern treatment, which is often not the case. It takes a sanatorium doctor some years to learn his business, so that it is impossible for the busy general practitioner to learn much from a few chance visits. Still, even chance visits would be useful; and regular consultations between the home doctor and the sanatorium doctor are highly advisable. It will rest with the family doctor to reform the domestic conditions when the patient returns to his home, unless this duty is performed by a whole-time tuberculosis officer without outside medical help.

THE COST OF TREATMENT.

Home treatment is of necessity more expensive than sanatorium treatment, if the same advantages are provided; but this is so often impossible that, under home treatment, something is usually dispensed with. Continuous medical supervision is necessarily lacking, the patient's meals are not supervised, the cleaning and ventilation are uncontrolled during a great part of the day and night, and there is nothing to prevent imprudences beyond the intelligence and willingness of the patient, which cannot always be depended upon. That many tuberculous patients do well under such imperfect conditions cannot be denied, but many such remain well without any treatment at all. Cases of pulmonary tuberculosis form a long series ranging from trivial to grave, so that some require less perfect measures than others. It is no argument that in some sanatoria the supervision is of a sketchy nature; these sanatoria are not fulfilling their proper duties, and should not be made the standard for others.

That many sanatoria have cost large sums, ranging from £300 per bed to more than double this sum, is also no argument

against sanatorium treatment, and no proof that it is more expensive than home treatment. Those who erect palaces instead of cottages for such purposes may be generous, but they are misguided. A simple sanatorium can be erected at less than the ordinary cost of cottage property, and in large groups the beds need not cost more than £60 per bed, including administration.

A great contrast between the style of the sanatorium quarters and that of the home defeats the objects of the sanatorium, since it is less useful as a model to be followed at home. It is a great mistake to spend much on bricks and mortar, and little on medical salaries; for skilled supervision is by far the most important feature of sanatorium treatment.

IMMEDIATE RESULTS OF SANATORIUM TREATMENT.

The results of sanatorium treatment depend so largely upon the nature of the case and the length of stay, that it is difficult to summarize them.

Early afebrile patients almost invariably improve enormously in general health, so that, after a few months, they look and feel better than they ever did. Local infiltration is but little altered by a three months' stay. The extent is often somewhat diminished, chest expansion increased, and dulness reduced in quality and extent. With dense infiltration, it is common to get a little increase here and there in the number of râles, which is a step towards recovery, and is replaced later on by freer air entry, reduction in râles, and perhaps more bronchial breathing. For complete resolution of any but the slightest local lesions, much longer than three months' treatment is required. The appearance of cavities in densely infiltrated patches is not necessarily a sign of retrogression; it may be a most satisfactory sign of improvement, if necrotic tissue has been replaced by a smooth-walled cavity. Diminution in expectoration, although usual, is not invariable in cases which are doing well. Disappearance of tubercle bacilli is a very uncertain test of improvement, because a small spot unhealed may continue to discharge tubercle bacilli freely, in spite of apparently perfect general health and almost complete disappearance of the physical signs denoting an active lesion. The average number of bacilli in specimens of sputa

is of no value taken alone. There are unfavourable cases with no tubercle bacilli in the sputum, and favourable ones with many.

Afebrile cases with extensive lesions also do very well under sanatorium treatment, although complete local repair is not possible.

Febrile cases with lesions of small extent sometimes do well, but sometimes it is impossible to arrest their progress. If the temperature comes down within a few weeks to normal, they usually make a good recovery ; but a cautious prognosis is always advisable, much more so than in the afebrile early and advanced cases.

COMPLETENESS OF THE RECOVERY.

This depends on the activity of the disease and the extent of the lesions. Destruction of lung tissue impairs the respiratory and, indirectly, other functions of the body, especially the circulation, so that after healing of an extensive lesion the patient may be unfit for heavy work. Still, graduated work will do wonders in bringing about compensatory changes.

PERMANENCE OF THE RECOVERY.

This is a test not so much of sanatorium treatment as of after-conditions. Recovery from tuberculous illness is almost always conditional, not absolute, and depends on the habits and conditions of life after leaving the sanatorium. To estimate the value of sanatorium treatment by length of survival, as has been done by some distinguished men, is absurd. The tuberculous who have never had any treatment at all probably survive longest ; but this is no argument that medical treatment shortens life. To ignore the conditions of life after discharge from the sanatorium is to leave out the major factor, and is as if we were to measure the value of colchicum or alkalies in gout by survival, regardless of habits and dietetics.

SANATORIUM STATISTICS.

In all statistical comparisons the rule should be followed of comparing like with like. Moreover, it is a mistake to attempt the comparison of mixed sets of pulmonary cases with one another, including early and advanced, febrile and afebrile ; for such a comparison is easily vitiated by differences

in the relative proportions of the heterogeneous elements.

Such statistics should take into account both the general and the pulmonary condition. It is of little use to compare the patients at one sanatorium and another, with a classification into three stages, according to Turban, but disregarding the degree of constitutional disturbance. The latter is of even greater importance than the former in forming a prognosis. At the International Tuberculosis Congress at Rome this year, I proposed a classification for comparative statistics based upon temperature, pulse rate, and state of nutrition, which corresponds in part with that of the American Medical Association, and with the temperature indications of Turban.¹ If this or some similar method were generally adopted, in addition to Turban's division into three stages according to the physical signs, it would do much to clear up the unnecessary ambiguity in tuberculosis statistics. Then, in dealing with afebrile cases, progress should be estimated by a physiological test, such as the amount of exercise which can be taken without constitutional disturbance.

I have suggested elsewhere a series of tests, corresponding with the stages of graduated exercise in use at the Crooksbury Sanatorium.² This would avoid the ambiguity involved in not distinguishing between fitness for light work and for heavy toil. Another ambiguity would be avoided if the results of approximately equal times of treatment were compared together. It is illogical to compare the results of three or four months' treatment in one place with those of a twelve-month elsewhere, as has occasionally been done.

Results based upon the arrest of the disease are of little use in estimating the value of sanatorium treatment here, because in this country the stay in a sanatorium is usually insufficient to ensure arrest, and because no patient can be certified as having arrest of his pulmonary disease until the signs and symptoms have been absent for at least a twelve-month. The common method of stating results as "much better," "better," "no better," "worse," or "dead," leave far too much to the personal impressions of the physician in charge of the cases, and are too little based on objective

¹ *Lancet*, July 20, 1912.

² *British Medical Journal*, October 12, 1912.

and measurable factors.

I have already referred to the fallacy of regarding the survival or continued good health of pulmonary cases as a test of the treatment adopted during a brief period. If the after-conditions are similar, this is a fair test; if not, it is illogical. It is not uncommon for a doctor to condemn sanatorium treatment, because during the next few months more progress was made by the same case at home. In such a case, the home treatment starts on a different basis, as it is built upon the results of the previous treatment. It is very common for the same case to make more rapid progress during later stages of treatment than the earlier ones, the treatment being the same throughout. It is also common to have fluctuations in the activity of the disease quite independently of the treatment adopted.

Many a doctor has got the credit for improvement due to the care of a predecessor, or to natural fluctuations in the disease; and this possibility must be borne in mind in estimating the value of sanatorium treatment.

THE SANATORIUM DEPENDENT ON OTHER AGENCIES.

The sanatorium is but one link in the chain of preventive and curative agencies concerned with pulmonary tubercle. Sanatorium treatment depends for its success largely on three factors, which are chiefly in the hands of others: on the supply of suitable cases, on a prolonged stay, and on adequate after-care. Time was when only early afebrile cases of tubercle were supposed to be curable by sanatorium treatment; but such cases are exceptional amongst those applying for admission to a British sanatorium. It is difficult to induce the average patient to undergo systematic treatment before he feels ill, although this is just when he would get the most benefit. It is equally difficult to induce him to remain when he feels "better than he felt for years," although his recovery may be far from assured. Patients going abroad are advised to stay the better part of two years; but patients in an English sanatorium are often told that a couple of months will suffice, which is absurd.

But, above all, the permanence of sanatorium treatment depends on *adequate after-care*; and this is usually lacking,

partly because the medical adviser does not realize the need of it, or has not learnt how to give it, partly for other reasons. To get the best results from sanatorium treatment, the disease should be recognized early, before the constitution is affected; every patient should be sent for an educational course of sanatorium treatment, his household systematically instructed in sanatorium ways, and careful provision should be made for a healthy life during the succeeding two or more years. Where the home conditions are unsatisfactory, the whole treatment should be carried out in a sanatorium at first, and a health camp afterwards. The dispensary, the sanatorium, and the health camp are essential to deal with working-class patients, and equivalent arrangements should be made for those in other ranks of life. Each has its part to play; each is inadequate without the other two agencies.

HEALTH CAMPS.

These are places in the country within reasonable distance of our centres of population where those who have been in a sanatorium, or who are suspected of tuberculous tendencies, or who are waiting for admission to a sanatorium but have not satisfactory home arrangements, may be received for the day or the night, or both, and may obtain suitable food at low cost. Cases should be excluded from such a health camp who are likely to be a source of danger to others. This includes the less promising patients who have been in a sanatorium, and those with open tuberculosis who have not been taught how to deal with the infectious discharges. If only closed pulmonary tubercle, and open tubercle with but little discharge, be admitted, and adequate medical supervision be provided, no harm will follow from mixing the tuberculous with non-tuberculous patients, although possibly such camps should be limited to those who show a positive reaction to tuberculin.

The difference between such a health camp and a sanatorium would be, that the inmates (or visitors) would be free to undertake work at a distance, and would not be subjected to all the usual sanatorium rules. There would be no systematic taking of temperatures, and medical supervision would be limited to the treatment of intercurrent ailments,

the prevention of infection, and a little hygienic instruction. Those visitors who remained during the daytime would spend their time chiefly in resting, in food taking, and in attending the hygiene classes. There would have to be a resident medical officer, a competent nurse, and a kitchen staff; but the visitors would be expected to wait on themselves and help in washing up, make their own beds, and keep their quarters tidy. The sleeping accommodation would be of the simplest, resembling that in an inexpensive sanatorium. It would be advisable to have separate sections for the men and women, with a smaller provision for married folk with their families. Arrangements would be made to bring out the visitors daily by motor bus or otherwise to the health camp, which represents the German "Erholungsstätte."

RECEPTION SANATORIA.

Arrangements are being made in many parts of this country for the reception of cases of pulmonary tuberculosis into special pavilions of isolation hospitals. Apart from the convenience of using existing structures, which are not continuously being employed for other purposes, there is a great advantage in having a number of reception sanatoria interposed between the dispensary and the sanatorium proper. It is often impossible to estimate the chances of recovery in a dispensary, owing to the absence of beds and the unsatisfactory surroundings of an urban dispensary; but if cases are sent on to a reception sanatorium for a short period of observation, they can then be forwarded to a nursing home or a sanatorium according to the indications; or at times it will be best to retain them for a course of tuberculin treatment while they are kept at rest. Ambulant tuberculin treatment is not always safe or applicable; but much progress may be made in a reception sanatorium under tuberculin treatment, and the strain reduced on the resources of the county sanatorium.



HOME TREATMENT OF TUBERCULOSIS, AND RULES FOR LIVING.

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THE essentials for the treatment of pulmonary tuberculosis are abundance of fresh air, a sufficient amount of nourishing food, a carefully regulated life, with freedom from worry, over-work, and everything calculated to lower the general health. To these essentials should be added specific treatment in certain cases. Well-ordered sanatoria give their patients all these essentials; hence it is that a period of residence in a sanatorium is the best education that can be obtained in home treatment. For all classes of consumptives, residence in a good sanatorium, if only for a few weeks, is of inestimable educational advantage.

HOME TREATMENT.

In the case of the well-to-do, home treatment should be a very simple problem to solve, the essentials for treatment are so readily obtained. Speaking generally, success or failure amongst such persons, depends more upon the character and determination of the patient and his friends, than upon any other factor. The happy-go-lucky, ill-balanced type rarely gets well. To those with limited means, home treatment is a matter of great importance. It is not in their power to select their place of residence, their occupation, etc., or to order their lives in accordance with the best advice. Many are unable to be away from their work whilst carrying out treatment, much less to go away for a time to a sanatorium or health resort. How best to give this large class of patient the advantages offered by sanatoria is a difficulty that often confronts the General Practitioner.

Fresh air, in abundance, by day and by night, is the first thing to secure. In many homes this is by no means easy. The difficulties may be in the nature of window deficiency, or an incompatibility of the patient's household to open-air living. The first can usually be overcome, if needs be, by

removing a window and replacing it by louvred shutters which can be swung right open. When closed against driving rain, they still allow free entry of air. A space in the wall above the door of a room, allowing of through ventilation, is of value. The aspect of the patient's room is of secondary importance, so long as it is airy. It is far better to have a large, well-ventilated room facing north even, than a stuffy little room with a southern exposure. It will be found that, in these respects, matters are simplified if the patient has a room to himself. He has not then to compel his family to share his abundance of air. Very often the best plan is for the patient to have some sort of open-air shelter.

Town dwellers are often well advised to live on the outskirts of the town. The air is purer, the country more easy of access, and there is greater probability of obtaining a small plot of garden or sufficient space for a shelter. However, when perforce the consumptive must live in the city, he should make up his mind to have plenty of the air that is about him; for anything is better than the closed window and stuffiness.

There should be no appreciable difference between the air in the room and the air outside the window. This is a good standard to work by. Public parks and the tops of tramcars are useful means of obtaining fresh air, with but little inconvenience. It is to be borne in mind that it is essential that patients should constantly wear clothes which are suited for open-air living; to shiver with cold in a chilly room is to court disaster. Equally important is it that heavy winter clothing be changed for something lighter on the advent of warm weather. One sees an extraordinary deal of ignorance with regard to clothing, resulting in discomfort, and sometimes in positive harm.

Rest and Exercise.—It is a difficult matter, when treating patients in their own homes, to impress upon them the curative value of absolute rest, or efficiently to regulate their exercise. This is unfortunate, inasmuch as no factor in the treatment is of greater importance than this question of rest and exercise. It is imperative that the patient be taught how and when to rest. He must be broken of the habit of "just getting about" when he thinks fit, which usually means that he tires

himself. The simplest method is to give the patient a time sheet for the day, stating clearly the times for rest, and the times for exercise. These directions can be revised every week.

For the actual regulation of the exercise, one is guided by the general condition of the patient, the temperature, and the pulse rate. Febrile patients, that is, those whose temperatures touch 100° F. or more during the day, are best kept at rest all day. A rapid pulse, or poor general health, also contra-indicate exercise. With increasing convalescence, walking exercise can be commenced with half a mile, morning and afternoon, this amount to be slowly increased. My own plan is to increase the exercise every fourth day, supposing progress to be satisfactory. When not walking, the patient should rest, and not loaf about. This is very important. When in doubt whether to prescribe rest or exercise, it is usually a sound policy to order rest. In every case, a rest of an hour before the midday and evening meals is very strongly to be recommended. This rest should be absolute, and preferably taken in the recumbent position.

Closely associated with the regulation of rest and exercise is the question of *Taking of Temperatures*. It is useless to overburden a patient with temperature observations and records. None the less, some accurate observations are almost indispensable, especially during the earlier part of treatment. The temperatures taken immediately on waking, and again at 6 p.m. or 7 p.m., after one hour's complete rest, are the most useful data. Personally, I much prefer rectal observations to any other, as being the most accurate. It is a simple matter to teach people to keep a record of their morning and evening temperatures, and one well worth the trouble. When tuberculin is given, it is even more important for the patient to keep some accurate records of his temperature.

Food.—Everyone realizes that the consumptive must eat heartily, but, unfortunately, many have but little knowledge as to the relative nutritive value and economy of the different foods. Ignorance on this subject is very marked amongst the poorer classes. The practitioner is well advised, then, to enquire into the details of his patients' diet, as by this means he is often enabled to put matters on a better footing. The

nutritive value of such cheap food-stuffs as oatmeal, lentils, herrings, separated milk, Dutch cheese, and dripping, for example, should be remembered when criticizing the diet of a patient of small means.

Prevention of Infection.—The prevention of the spread of infection should be a prominent feature in home treatment. The tuberculous patient should have at least a separate bed, and, when possible, a separate bedroom. It should be seen that he uses some sort of sputum-cup or bottle—the wide-mouthed glass bottle with rubber stopper is a good pattern—and knows how to destroy his sputum. Cleanliness of the patient's room should also be insisted on. This, for the most part, is a question of simple, easily-washed furniture, no hangings, no laid-down carpets, and the liberal use of soap and water.

RULES FOR LIVING WHEN NO LONGER UNDER ROUTINE MEDICAL
SUPERVISION.

It is notorious that it is one thing greatly to improve a consumptive, even apparently to cure him, and quite another to keep him in this favourable condition. This, of course, is due to the fact that tuberculosis, when definitely present, is very difficult to eradicate. The three months or so, during which the average patient may be under fairly strict medical supervision is rarely sufficient time for anyone with tubercle bacilli in his sputum to lose them. However well the patient may appear, the fact that the bacilli are still present in his sputum is evidence of the risk of subsequent relapse. Experience has shown that this risk is very materially lessened, if the patient has the wisdom and opportunity to embody in his every-day life the fundamental principles of sanatorium treatment. Thus it is that after-care, namely, teaching patients how to continue their treatment on their own resources, is becoming more and more widely recognized as an absolutely essential factor in the treatment of tuberculosis.

A patient should carefully analyse the daily routine he was following at the time he broke down with tuberculosis. He should seek to eliminate every possible element which, he knows, is calculated to lower the standard of his general well-being. Further, he should make a serious effort to introduce into his life the principle which he has learnt to recognize as

the means of restoring health.

Fresh Air.—Every possible means should be taken to get fresh air. After the working hours are over, this is simple enough. The bedroom window should be always wide open, and the living room should be always airy. The wise man will cultivate a liking for out-door recreations. Gardening is greatly to be recommended, on however humble a scale it may be. The summer evenings may well be spent in the garden or somewhere else out of doors, and, during the winter, the warmth of a fire is quite compatible with an airy room. Saturday afternoons and Sundays should be the means of getting an abundance of fresh air. The town worker, when he can afford it, can with advantage sleep in the country, or at least go into the country fairly often for week-ends. As far as possible, ill-ventilated, and stuffy places must be avoided, for example, public meetings of all kinds, music halls, public houses, etc., and, in many cases, friends' houses. When choosing a place to live in, one should be guided by personal experience. Most people know the kind of climate in which they feel the fittest. If the consumptive seeks advice on this point, he has only to ask himself this question. For some, a bracing air is the best thing, for others, a relaxing climate. Some are best at the sea; others, again, are better inland. There is no panacea in any particular place or climate. The thing to avoid is a damp-holding, or ill-drained subsoil, such as clay. A soil of gravel or sand should be the objective.

Meals.—General nutrition cannot be maintained without sufficient food. The consumptive, who has been habitually careless about his meals, must reform his habits. His meals in future will be regular and adequate. There is no call for stuffing or anything approaching it, only for good honest meals, taken regularly, and sufficient time in which to eat them. The importance of the care of the teeth is often overlooked. The periodic visit to a competent dentist makes for good digestion and good nutrition; in fact, the consumptive should regard dentistry as an important part of his treatment.

If money in the past has been spent upon beer and spirits, this sum should be diverted to the purchase of milk or other food; indeed, any tuberculous patient is the gainer by giving

up alcohol altogether.

Occupation.—The question of occupation often presents difficulties, since a fresh air life is quite incompatible with many kinds of employment. Here, again, the consumptive has to exercise considerable judgment. In the large majority of cases, it is impossible for a patient to do otherwise than return to his ordinary employment, be it suitable or unsuitable. If unsuitable, an effort should be made at least to modify it in some way, for example, by shortening the hours of work for a time. In big business houses, it is often possible to get a transfer from indoor to outdoor work, without entailing serious financial loss. For example, I have known quite a number of insurance office clerks take up agency work ; office workers take up commercial travelling ; engineers take up motor-car driving, etc. Emigration is sometimes a way out of this difficulty of an unsuitable occupation, but it is an alternative which requires the most careful consideration. Apart from the well-to-do classes, no consumptive should think of emigrating until fully restored to health and the capacity for work. The emigrant also should have a definite post to which to go out, or at least sufficient money to keep himself for a month or two, whilst looking for work. Those who follow certain professions and occupations are very happily placed, in that, they can obtain suitable work without difficulty. Clergy of all denominations, medical men, hospital nurses, and school teachers, in many cases, to mention a few examples, can always exchange town for the country, and should do so.

Rest and Exercise.—The consumptive should try and secure a certain amount of absolute rest during the day, if only for half-an-hour before his evening meal. He should go to bed early, and keep regular hours. Those who follow sedentary occupations should contrive to fit into their daily routine some steady walking exercise, but anything like violent exercise should be avoided. Of outdoor games and recreations, walking, cycling, bowls, and, in moderation, golf, are amongst the most suitable.

Some General Hints.—An eye should be kept on the body weight. It is well to weigh once every two or three weeks, but always on the same machine, at the same time of day, and in approximately the same clothes. A slight loss of

weight on return to work after a spell of treatment is nothing to worry about, but a steady consistent loss of weight should be regarded with suspicion. A monthly medical examination, as a matter of routine until the cure is apparently complete, is also to be recommended.

I do not advise the taking of temperatures by the patient who is no longer doing serious treatment. It is impossible for the layman correctly to interpret the fluctuations of the temperature curve. The attempt to do so is not infrequently a source of worry and anxiety. It is a good plan, however, to take the temperature when feeling unwell, since a raised temperature is an indication that medical advice should be sought. Blood spitting, increase of cough and sputum, a feeling of tiredness, indigestion, and irritability are also indications that all may not be well. Such symptoms should not not be overlooked or ignored, but, at the same time, they should not continually be looked for.

The patient with arrested or quiescent disease should have an intelligent appreciation of his condition and its attendant risks. There is nothing to be gained by allowing him to deceive himself on this point. This knowledge, however, should be only at the back of his mind, so to speak. Nothing is worse for all concerned than constant self-analysis and thinking about the disease. So long as a patient feels well, looks well, and maintains his weight and general condition, he may safely assume that his progress is satisfactory.

As a conclusion to this short article, I cannot do better than quote from a letter, just received from a former patient on this subject of rules for living :—"With regard to after-care, I only carry on treatment in so far as the discipline and training of the sanatorium has made it second nature with me to observe certain laws. For instance, I make myself eat enough. In the old days, I ate when I wished, and not much at that. I never fail to look out for fresh clean air. I sleep in a breeze, winter and summer. I look on a draught as an angel from heaven. I choose open-air recreations rather than the theatre, etc., and always keep myself busy. By so doing I have no time to think of tuberculosis, but at the same time I never forget that I may still have got the damned thing in me."



TREATMENT OF PULMONARY TUBERCULOSIS BY
GRADUATED REST AND EXERCISE.

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TREATMENT by means of rest and exercise is a logical deduction from the theory of auto-inoculation. The word, auto-inoculation, is descriptive of a process which consists in the introduction of bacterial products into the blood. In Wright's words, "all active and passive movements which affect the focus of infection, and all vascular changes which activate the lymph stream in such a focus," induce auto-inoculations by means of which the blood begins to provide of itself a protective mechanism. The process is one of immunization, and, as a consequence, whenever bacterial products escape from the localized foci "intoxication phenomena and immunizing responses must necessarily supervene." The result depends upon the adequacy of such responses; where the auto-inoculations continue and the immunization process is weak, death is the end inevitably; where the defence is progressively equal to the attack, the assaults of the bacterial products are gradually worn down until the rising levels of resistance produce in the end complete immunity.

To make use of this natural process for the purposes of treatment is necessary and practically possible, provided that a sufficient system of control can be maintained. The control must be two-fold. In the first place, there is the holding back of auto-inoculations which the protective substances in the blood are unable to withstand, and secondly, there is the inducement by the physician of auto-inoculations carefully adjusted to the strength of the protective substances in the blood. This adjustment of the artificial inducement of bacterial products is vitally necessary, since there is always the danger of exciting doses so excessive in character that they may overwhelm the resisting forces. Uncontrolled doses are in the last degree disastrous. The result is to produce

a lower level of resistance, and a corresponding ascendancy of the bacterial products.

The position from the point of view of treatment in simple terms is this; the resisting properties of the blood confer immunity, and it is possible to assist in this natural process of immunization. This assistance is twofold in character, being indeed the question of control restated; "rest" is the control which is devised to check excessive auto-inoculation when the response is weak, and "exercise" the artificial stimulant of auto-inoculation when the response is likely to be adequate.

Treatment by means of exercise is not of universal application; it can only be used in the case of a patient who fulfils two rather onerous conditions. In the first place, he must be afebrile and quite free from all constitutional symptoms; and secondly, he must have attained the position of an ordinary person in the house, by being able to remain up all day fully dressed, and to walk up and down stairs. These conditions can only be satisfied by two classes of tuberculous subjects. Taking the following classification:—

Class I.—Those who have been infected and have recovered without knowing of their infection;

Class II.—Those patients whose recovery is certain after rest and a holiday;

Class III.—Those patients who require additional help to that conferred by general hygiene;

Class IV.—Those patients for whom no treatment will do any good;

there are only Classes 2 and 3 to whom treatment of the type under consideration is possible. These again can be divided into the febrile patients, and patients free from fever.

It is clearly important to increase as much as possible this latter class of patient at the expense of the other classes, and, in the case of the febrile patient, this is attained by complete immobilization until the fever is gone. This control of excessive auto-inoculation by absolute rest is complementary to its artificial inducement by exercise, and must instantly be adopted upon the slightest return of fever. Fever means a temperature exceeding 99° F. in men and in women $99^{\circ}\cdot6$ F.,

accompanied by constitutional symptoms, such as malaise, headache, and similar signs of hyper-intoxication. If there are no general symptoms, these temperatures may be disregarded, inasmuch as they are merely indications that auto-inoculations are taking place, but not to any excess. Even a temperature of 100° F., in a case in which there are extensive signs in the lungs, can be ignored, provided that there is absence of constitutional disturbance. The immobilization must be absolutely effective; it is not sufficient to send the patient to bed and allow him to wash himself, or visit the lavatory. He must not be allowed to move or to read; talking must be forbidden, and steps taken to repress any needless coughing, if necessary, by wearing a Burney Yeo's inhaler; the use of the stethoscope is debarred, since it entails the taking of deep breaths. Visitors should be kept at a distance, and even the patients' letters should be withheld, if there is any probability of home worries intruding.

Six to ten days of this régime are, in most cases, sufficient to bring the temperature down to its normal level; moderate movement is then permissible; for several days, the patient may be propped up in bed and allowed to read. If the temperature continues normal, half an hour's sitting up in bed should be granted, this period being gradually extended until the patient is able to dress, and remain up fully clothed throughout the day.

Should a prolonged trial be given to immobilization without reducing the fever or dispelling the untoward general symptoms, a further step in the direction of more complete immobilization may be considered. The method is to introduce nitrogen into the pleural cavity, and it is in some cases of great utility, inasmuch as it checks the movement of the lung by neutralizing the intrapleural negative pressure.

The patient is now ready to enter into the second control. The object to be attained is the raising of the specific resistance by gradually inducing larger and larger doses of his bacterial products to enter the blood, the protective substances of which are trained to deal with them. The motivity of the lungs is increased, together with a restoration of the patient's physical capacity.

The system devised to accomplish this end is known as

graduated exercise or systematic labour. There are six grades of labour, preceded by a period of preliminary treatment by means of walking exercise. The latter varies according to the individual, and must be judged in each case upon its merits. The patient who has been immobilized, owing to the presence of fever and constitutional symptoms, begins by walking 440 yards a day. This exercise is the only variant to complete rest; were it not so, there could be little accurate control over the doses of bacterial products. The temperature and constitutional symptoms form the guide throughout, and, should there be no marked deviation, this exercise is continued for a week, and is then increased to 880 yards per day. The third week, two miles is the prescribed distance, which is increased to four in the last week of the month.

The final walking stage is over a distance of six miles, and is generally attained automatically. Should the patient, however, at any stage show signs of headache, unfitness, or increase of sputum, he must either be rested or kept on his existent grade, until these signs disappear.

The patient, who has *not* been through a period of complete immobilization, may generally be started on four miles a day, while a man who has been at work, previous to his period of rest, may be judged capable of resistance to any dose of bacterial products that six miles a day can place in his blood.

Physical signs are generally misinterpreted. Cavities, for instance, involving four lobes, with good muscular condition, form no reason for the prescription of the quarter-mile grade; such a patient can without hesitation be started on the four or six miles grade, whereas the patient having little or no physical signs, but with wretched physique, must be watched carefully. His protective substances are weak and incapable of much resistance. The period of a week given to each of these stages may seem at first view unnecessarily long. There is, however, quite a valid reason, inasmuch as the restoration of their physical capacity being the ultimate aim of this system of treatment, it is not sufficient merely to cause the required auto-inoculation, which may possibly be done in a single day, but so to habituate the muscles of the patient, to this exercise, that he will be able to withstand the further stage without

undue fatigue.

The grades of labour are now entered upon successively, subject, of course, to no revival of unfavourable symptoms. Grade I. consists in carrying, for a distance of 50 yards up a gradient of 1 in 10·7, baskets containing materials and averaging about 10 lbs. in weight. The number of times daily should be adjusted to a distance of seven miles. There are substitutes for this basket-work, such as indoor painting, watering plants, etc. Walking is less useful owing to the lack of equivalent training to the muscles of the arms, while any task which permits the personal factor to come in by way of excessive zeal is disastrous. Basket-work is capable of being held within strict limits, and any manifestation of zeal is easily detected and repressed.

Grade II. is a slight extension of grade I.; 18 lbs. of material are carried a longer distance in a larger basket, while the third grade allows of more arduous work, such as chopping firewood, cutting grass, hoeing, etc. The fourth grade is shovel work, or its equivalents, mowing grass, sawing trees, etc. Two tons of earth lifted into a cart is the daily task in the beginning, gradually increasing to about twice that amount. In grade V., six tons a day is the prescribed amount, a larger shovel being used, while patients in the last grade are required to do five and a half hours of the heaviest type of navy work. The times necessary for the various grades vary according to circumstances, but a fair average is as follows:—Grade I., one week; grade II., one or two weeks; grade III., one or two weeks; grade IV., two weeks; grade V., three weeks, and the patient is then permitted three weeks from his discharge to work on the heaviest grade.

It is clear that the successful passage of the patient through these various grades is a progressive enhancement of his physical capacity, which should always have as its end the discharge of the patient ready to resume his ordinary work. Consequently, where possible, the final stage should develop the muscles, which are necessary to the particular trade in which the patient is engaged, and opportunity should be given for practice in the trade, or in an occupation as nearly akin thereto, as is practicable.

An important aspect of a system of sanatorium treatment

is the demoralization of the sick produced by the mental and physical lassitude of long periods of inactivity. Graduated labour from this point of view has a psychological and moral value impossible to over-emphasize. Listlessness disappears under such a régime, and the criticism that basket-work is monotonous must fall to the ground, if it is made evident that the work is immediately necessary and useful. Some large scheme of construction should be in progress at the sanatorium permitting of the co-ordination of the various grades of labour, in an end sufficiently stimulating to the imagination of the patients. For instance, at the conclusion of the day five "small" basket and five "large" basket men will have moved a heap of about five tons, and at the end of a five and a half day week about $27\frac{1}{2}$ tons. This is a visible and tangible result. The graduation of the work, too, has an ameliorative influence upon the mental life; the man feels his physical powers increasing, and marks them by his rapid advance from grade to grade; his progress is evident quite apart from medical prompting.

Graduated exercise for women follows precisely parallel lines, the work being, of course, less arduous, and the implements used are lighter. They cultivate a kitchen garden, take charge of the poultry, and generally do the light work of their own quarters.

Throughout the whole of this system the control of auto-inoculation must be unremitting. The first sign of an excessive dose is loss of appetite. The immediate reply is the lowering of the grade. The quantity of sputum has to be watched well; a progressive increase in expectoration is an almost certain sign that the patient is being worked beyond his full capacity, and he should be rested for a few days, or reduced to a lower grade until the sputum diminishes. Should the dose of bacterial products induced be sufficient to excite fever or constitutional symptoms, nothing is of service except complete immobilization. A return to the same grade is in most cases possible. A preliminary test is, however, useful, and can be applied by making the patient walk six miles without an increase of temperature.

Among the general cautions to be regarded there is one of primary importance, which is to keep a constant watch

upon the patients at work. If men are working in gangs one may be physically unfit to keep pace with his fellows, or there may be a general tendency to excessive zeal, which must be checked. Again, the patients must, whether in bed or at exercise, have a good supply of pure air with sufficient shelter from boisterous winds. The routine must be rigid, enforced by strict discipline, and the work periods should be allocated rationally in the day. The following time-table is suggested as consistent with current conceptions of the nature of tuberculosis, and as being widely adopted in sanatoriums throughout the world:—

6.45.—Patients rise, clean wards, dress and shave.

8.15.—Breakfast.

9–9.30.—Those who use tobacco, smoke.

9.30–10.—Clean brass work, etc.

10–12.—Graduated work.

12–12.45.—Rest for all, except those within three weeks of discharge.

1.0.—Dinner.

1.45–2.30.—Rest ; smoke.

2.30–5.—Work. Walking exercise commences at 3.0.

5–6.30.—Recreation.

6.30.—Supper.

7.15–8.0.—Rest ; smoke.

8.0.—Prayers.

8.30.—Lights out.

9.0.—Silence.

The work periods are seen to amount to four and a half hours in all, with a possible increase for those persons nearing their discharge of about three-quarters of an hour.

Sunday is a day of rest.

Thus far, it has been assumed that the patient is in a sanatorium under hourly observation. It is difficult for the patient who lacks the moral support of his fellows to keep rigidly to a time-table of systematic work. When treatment, however, has to be carried out at home, it is possible to eliminate the basket work and equivalent labour of the first three grades altogether, and to substitute walking. The mileage is increased, up to about 14 miles, step by step, until four and a

half to five hours a day walking per day is reached. The one disadvantage in walking is that the muscles of the arms are not sufficiently exercised, but an effective counterpoise can be supplied by dumb-bell exercise. Five minutes per day, if the dumb-bells are of substantial weight, is sufficient for the patient at the beginning, the time being extended to a maximum of half an hour. The two exercises are to be regarded as complementary, and an increase of dumb-bell exercise may go with reduced walking, or vice versâ. Driving is an excellent arm exercise.

The fourth grade of the sanatorium can be replaced for the patient at home by one round of golf (18 holes). Golf is better than games in which excessive over-exertion is easily possible, as in tennis or cricket, though a general caution to the patient should be given against strain. Grades V. and VI. can also be worked out on the golf course, the final stage being represented by three full rounds in one day.

These general principles are suggestions merely; other possibilities are open to the patient at home, provided that there is an intelligent grading and consideration of individual need.

The question of diet is an important one in any system of graduated exercise. The old dietary, which was chiefly a milk routine, has now almost universally been abandoned. Fat deposits on the omentum were the usual consequences of the early methods, and the shortness of breath which resulted would find no place in a severe work régime. The new method is to provide patients with the quantity and the quality of food which is within their means when at home.

The labour of the patient is found to be a splendid incitement to a good appetite. There is an appreciable decline in the quantity of food consumed on Sundays when the work periods are absent. Three meals a day are sufficient. The aim of the physician is to produce a hard physical condition, and he should study the diet with the object of making it a co-operative force to that end.



THE CLIMATIC TREATMENT OF TUBERCULOSIS.

BY NEVILLE WOOD, M.D., M.R.C.P.

IN the treatment of tuberculosis, so widespread is the belief in the efficacy of climate, that all of us, from time to time, are called upon to choose one that is suitable. It is, therefore, as well to recognize that this is a problem from which there is no escape; for we are just as much selecting a climate whether we advise a patient to remain at home, or insist on his removal to some other place. A consideration of equal importance is, that of all the therapeutic measures at our disposal, this one alone is uninterrupted in its action.

When endeavouring to turn our knowledge to practical account, however, we are faced with an initial difficulty which calls for mention in every discussion on the influence of climates. It is that, while climate is a general term meaning the average state of the weather to be expected in a given region for a given period, the difference between expectation and reality is apt to be disconcerting, as it was, for instance, in the summers of 1911 and 1912, when drought was succeeded by deluge. Other difficulties are due to the great complexity of the disease and its many complications, as well as the differences in the reaction of various patients to similar atmospheric stimuli.

In this article discussion will be limited to those forms of tuberculosis which are undoubtedly influenced by climatic treatment—the pulmonary and the so-called surgical.

PULMONARY TUBERCULOSIS.

As we learn from history, this disease was the first for which climatic treatment was advocated; while from early times to the present day, although there have been many changes in medical opinion, the importance of the quality of the air in the different localities selected has never entirely been lost sight of. Such changes were inevitable; for, in the past, too much reliance was placed on the impressions received by physicians, who were without sufficient informa-

tion concerning the daily occupation of the patients whom they had sent to distant countries, and whose life histories they could but seldom follow to the close. Hence, from time to time, different types of climate came into favour, only to fall into disrepute in their turn.

Owing to the world-wide adoption of sanatorium treatment a great mass of statistical evidence is now at our disposal, and we may reasonably hope before long to be able to draw definite conclusions from this source. In the meantime, it should be noted that there is a tendency, among representatives of the younger school of thought, to interpret the figures as showing that the climatic factor is of minor importance.

In support of this contention it is pointed out that results as good, or perhaps a little better, have been recorded at a sanatorium in Scandinavia standing nearly at sea level as at another situated in the Swiss Alps. Many other instances of like import might be cited—among them the great success attending open-air treatment at a London infirmary, by no means ideal in situation.

I think that the inference to be drawn from such observations is, that for unselected cases the results obtained will be nearly alike in widely differing climates, if the best features of each local climate are turned to good account, while protection is afforded against the less favourable elements—an ideal for the most part only to be realized fully in a well-directed sanatorium.

For individual cases, however, and especially for those which are not to be submitted to institutional control—and with these alone I am concerned here—careful selection is required. We must remember that a climate cannot be separated from a place, and we have to consider how far the other local resources, in conjunction with the climate, are likely to induce a particular patient to conform to the routine prescribed for him. It is easy enough to persuade most invalids to make sufficiently good use of the greater part of their time, but it is very much more difficult to ensure that each hour shall be spent in the most profitable manner.

Some years ago, in South Africa, I had exceptional opportunities for observing the daily lives of a number of young men, sent out in the belief that "the climate of the Cape"

would effect a cure. I found that striking improvement took place only in those who had no occupation keeping them indoors, and who followed the local custom of taking their pleasure on horseback, while making their journeys in that way, or by "trek." Living and sleeping in the open they came to regard the shelter of a roof as oppressive. Before the doctrine of the open air had been established, temperament at first, and experience afterwards, led them to extract all the advantages of a superb climate. The reputation of that climate still rests upon the wonderful results accruing in instances like these.

On the other hand, bank clerks, store assistants, and even curates, who had exchanged appointments at home for similar employment in the sub-continent, very rarely derived substantial benefit. Many of them, indeed, would have done much better at home, where at any rate they would have avoided excessive heat, dust storms, tough or canned food, and the risk of typhoid from defective sanitation.

The moral to be drawn—and *mutatis mutandis* to be applied to other regions—is that South Africa is entirely unsuitable for phthisical subjects who are obliged to work for a living, indoors. Moreover, it is too hot in summer for an invalid to undertake outdoor labour; while if he is anchored all the year round in one place he will be at a great disadvantage. It could scarcely be surpassed, however, for any moderately vigorous person, exempt from financial cares, who feels the fascination of the veld, and is wise enough to spend the summer at the coast and the winter in the uplands, and so to enjoy in the year 10, or perhaps 12, almost rainless months.

In pulmonary tuberculosis, as in other diseases of bacterial origin, there are stages during which our chief endeavour must be to conserve the strength of the patient, and other stages when we can call on the vital forces to overcome the invading micro-organisms. The times for protective treatment are, of course, those of the fever of onset and of relapse; and later, that of exhaustion, when mixed infection plays such a sinister rôle. Other indications for protection are delicacy of constitution, and infirmity from age. Under these latter conditions, a mild equable climate is to be preferred, but we must be assured that artificial heat of a healthy kind is available should

the weather become for a time inclement. The temperature should be that which secures the well-being of the whole organism with the least possible expenditure of energy on its part. This temperature, called, oddly enough, "critical" by Ranke, is from 59° to 60° F.

Places meeting this requirement are to be found in the temperate zone at low altitudes, and usually not far from the sea; although the actual sea front, as insisted on by Dr. W. Gordon, should always be avoided. The stages at which stimulation is required—at which all the processes of nutrition are to be compelled to the highest possible activity, are the pretubercular, and later on the periods of quiescence or arrest. The suitable subjects are those from adolescence to middle age, and of robust constitution apart from the effects of local disease. Digestion must be good, circulation active, and there must be sufficient lung capacity. For patients coming under this category, a cool climate with rather wide diurnal variations of temperature, or a cold one with slightly less difference in range, is the most desirable. There should be little wind, abundance of sunshine, and a minimum of dust. Needless to say, that in winter these conditions are better satisfied at Davos than at any other accessible spot. In that still air, the invalid may stroll in the hours near to midday, without even an overcoat, though his eyes are protected from the reflection of the bright sunlight by smoked glasses; while at night, with an open window, he will be glad sometimes, to turn on his "coil" to temper the extreme cold.

In sending patients to climates with a wide diurnal range of temperature, and in which that potent tonic cold—the iron of the atmosphere—is a factor of chief importance, the stake we are playing for is nothing less than the permanent arrest of the disease, by fortifying the tissues of the host, such host being, *ex hypothesi*, sufficiently robust for intensive measures.

The circumstance rendering the variations in temperature, at a place like Davos, of such great value is that their regularity facilitates a process of adaptation on the part of the constitution of the patient. It is in this essential that the climate of our own country fails, and this it is that leads us so frequently to prefer foreign climates of greater stability, especially when daily, nay hourly, guidance as at a sanatorium

is not to be made use of. As Dr. Burney Yeo points out, in England we may be favoured with a period of crisp, dry cold, and then, just as the organism is adapting itself to dry external cold, there comes a spell of soft moisture-laden south-westerly winds, to be followed, perhaps, by harshly cold weather. Such vagaries render extremely difficult the management of cases attended by much catarrh.

Lately, there has been devised a plan of attack on the disease by the employment of a specific—I refer to auto-inoculation by means of regulated physical exercise. This method can be employed with hope of success in any climate not otherwise unsuitable, and, should further reports of its efficacy confirm those already received, less minute attention to the qualities of the atmosphere will become permissible. Already, indeed, a growing belief in the value of kinetics, added to the recognition of the amazing effects of fresh air in superabundance, is leading us to hear less, than was formerly the case, of Madeira, the Andes, Bogota, and Denver—perhaps a little less even of Egypt and Davos—all places with highly specialized climates.

Sea voyages, moreover, have fallen into some disrepute, and, as I think, rightly. They are best adapted for a limited number of debilitated subjects, who are believed to be threatened with pulmonary tuberculosis, and for cases in which it is certain that the disease has definitely been arrested.

There remain a few words to be said on the choice to be made in the presence of certain prominent symptoms, or of extra-pulmonary complications—a more restricted subject, which gives greater practical value to the mention of different localities by name.

For hæmoptysis, a distinction must be drawn between that occurring in the early stages and that which takes place from the walls of cavities at a later period. Cases belonging to the second category should not be sent to high altitudes, while in the earlier stages no such precaution is necessary.

High altitudes are unsuitable for persons who are unduly sensitive to cold, whether this is due to age, cardiac enfeeblement, malnutrition, or to collapse or destruction of extensive areas of the lungs.

For most cases of pharyngitis, a rather warm air, with a

moderate degree of humidity, is preferable. This condition is met with at the better sheltered resorts of our south-west and west coasts, and with higher temperatures at Arcachon, Biarritz, St. Jean de Luz, and Estoril; or, again, at places of moderate elevation and hence with less humidity, such as Grasse, or, still higher, at some of the Pyrenean resorts, as Cambo or Cauterets, the last a special favourite with French vocalists. Very much the same holds true for laryngitis, but a rather larger proportion of these cases do well at the higher altitudes.

To effect the arrest of chronic rhinitis, a very dry air is almost always required, and the choice may well be the high Alps in summer, and Egypt in winter. The drawback to the employment of these extremely dry climates is the strong probability of early relapse on a return to places with much greater humidity. For that reason, a trial may be made of the moorlands of England or Scotland, the Tyrol, Saxon Switzerland, or the Swiss Alps at an elevation of about 3,000 feet.

General principles are the best guide in bronchial catarrh, it being remembered that expectoration is favoured by warmth and moisture, and checked by the opposite conditions. For dry catarrh, Madeira or Algiers are much in favour, or nearer home Arcachon, and in our own country Falmouth, Torquay, and Sidmouth. When there is much expectoration, Egypt, the Riviera, Meran, and in England, Hastings, Bournemouth or Ventnor should be thought of. For catarrh of both varieties (except in very robust subjects) the high Alps should be avoided in winter.

When there is much emphysema, with rigidity of the chest walls, high altitudes are unsuitable. The patient may suitably be sent to the warmer of our seaside stations, to Egypt, or the Riviera.

For that distressing complication bronchiectasis, more positive benefit may be expected from the very dry air of the Egyptian desert than from any other; but no climate is of much avail unless attention is given daily to the "pulmonary toilette." That region is also held to be specially indicated for various extra-pulmonary complications, anæmia, albuminuria, disease of the cardio-vascular system and, according to

Dr. Leigh Canney, for dyspepsia.

In all the phases of pulmonary tuberculosis, very hot climates are injurious, even if they were found agreeable before the onset of the malady. Accepting, as in great part I think we must, opsonic theories, I suggest that in addition to its debilitating influence on the whole system excessive heat may lead to undue prolongation of the negative phase.

Lastly, there is the closing stage of phthisis, when the sole consideration is how and where the sufferer shall end his days with a minimum of misery—and that is usually in his own home.

SURGICAL TUBERCULOSIS.

By this term is commonly meant tuberculosis of the glands, bones, and joints; usually there is no additional involvement of the respiratory tract. In some cases, indeed, tuberculous glands appear to exert a protective influence. The disease is commonly of indolent type, and, because its focus is in an area of diminished circulatory activity, auto-inoculation is not prone to be excessive. Consequently, there is little impairment of vital energy, and, unless from involvement of the spine or the lower limbs, very little interference with activity. It is, therefore, safe, as a rule, to stimulate nutrition by every possible means, and for such stimulation a bracing climate is, of course, the best. There is in this country, though not in Germany, a consensus of opinion that the most rapid as well as the most permanent results are obtained from marine climates. For these invalids, wind—even east wind—is not to be feared, and we find in Britain a preference for the seaside resorts of the east coast, and especially for the Isle of Thanet. For delicate children of school age, Broadstairs has great advantages. For the more robust, whether children or adults, Margate or Westgate are chosen; the only reproach levelled against the latter being a quietude encroaching on dulness. Ramsgate enjoys a softer air and has attractions for the elderly, or for anyone who can find sufficient pleasure in the daily contemplation of the pretty little harbour—the only picturesque peep on the Isle.

Experience, or as some would have it fashion—but if the latter, of the kind that has not veered—has placed Thanet first,

and other districts in comparison "nowhere." As a matter of fact, however, results which could scarcely be surpassed are obtained at many other places on our east and south-east coasts. It is my conviction, however, that for the treatment both of the diathesis and of the local lesions, the south-west and west coasts of the British Isles have been neglected unduly. The air at these stations is of the greatest purity. It is warmer in winter, and less raw in wet weather at all seasons, than at the places usually selected, so that the enfeebled, at any rate, may sit on verandahs on wet days, when on the east coast the shelter of the house would be sought and, perhaps, the windows shut.

It should be remembered, however, that there are patients who do not thrive by the sea. For this group we have a very wide choice of resorts, including Dartmoor with its keen and stimulating air, the moorlands of Yorkshire or of Scotland, and many hill stations of moderate altitude such as Malvern, Church Stretton, Crowborough, or Hindhead. Nor should our spas, though better known for their mineral springs, be forgotten. Some of them, such as Harrogate, Buxton and Llandrindod, are, in addition, climatic stations of a very high order.

Finally, it is necessary to state with all emphasis that climatic treatment, though frequently of greater importance than any other single factor, should never be relied on alone for the management of any of the manifestations of tuberculosis. For surgical tuberculosis, air, especially sea air, is often prescribed in the hope of avoiding operation; but patients, not few in number, come back from the sea with glands which have broken down—evidence of hope clung to unduly long, or that a primary focus of infection, which should have been removed, has been overlooked. Even in the most suitable of climates, close medical supervision is indispensable. It should be persisted in until it is certain that no calamity is impending, and until the patient has become confirmed in the habit of turning to the best account the climate in which he is living. That is the Alpha and Omega of climatic treatment for all maladies.



DIETETIC TREATMENT OF TUBERCULOSIS.

By CHALMERS WATSON, M.D., F.R.C.P.E.

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TUBERCULOSIS is essentially a wasting disease, prominent features being, loss of appetite, disturbed digestion, interference with assimilation, and a resultant loss of flesh. One essential in treatment, therefore, is to increase the resistant and recuperative powers of the body by getting the patient to eat properly and also a sufficient amount.

There can be no hard-and-fast rules for the dietary in tuberculosis. The disease may show itself at all ages and in many varied forms; the stage and severity of the disease, and the presence or absence of special complications have to be considered. Thus, the diet of a young subject affected with acute tuberculosis, in whom there is extensive and active mischief with fever and general constitutional disturbance, differs from that of a patient whose weight is almost average for his height and in whom there is a limited and quiescent lesion.

In order to present the subject in as practical a manner as possible, it will be convenient to discuss it in the following order:—

1. *General principles.*
2. *Tuberculosis in cases with impaired digestion.*
3. *Diet suitable for the well-to-do classes.*
4. *Diet amongst the working classes.*
5. *Prophylactic treatment for children of tuberculous tendency.*

GENERAL PRINCIPLES.

In considering the principles of feeding, it is necessary to refer to the importance of thorough oxygenation of the blood, a therapeutic factor which bears directly on the processes of general nutrition. As the proper method of oxygenating the blood is by the continual supply of fresh air and sunlight, the patient should, so far as possible, live in the fresh air, irrespective of the weather. This promotes a good appetite, increases the digestive powers, and so enables the full effects of a judicious dietary to be obtained. A further important

point is that breathing should be carried out properly. It is of comparatively little value to put a child or young person, who is a mouth-breather, on to a proper dietary, if the oxygenating power of the blood and tissues is greatly below the normal, from a cause which can readily be removed. Breathing exercises, carried out in a systematic and thorough manner, are frequently of the greatest value in these cases.

The main point in the dietetic treatment is to increase the amount of food, so that the patient's weight shall increase, and remain stationary at a little in excess of the patient's known weight before becoming infected with tuberculosis. The system of forced feeding or stuffing, which was in vogue for a short time, has rightly fallen into disrepute. That system led, it is true, to a great increase in weight, but the increase was an unhealthy one, and it was not associated with an increase in vigour or resistance, but the reverse. It may now safely be stated that those physicians, who use the lowest dietary standards consistent with satisfactory gain in weight, are adopting the soundest lines of treatment.

While the food as a whole has to be increased, special importance attaches to the increase of the proteins and fats. As a rough estimate of the extent to which the nutritive material should exceed the normal diet of a non-tuberculous subject, it may be laid down that the diet in a case of tuberculosis should contain about one third more. Of this third, the greater part should be given in the form of animal proteins, and more especially meat, eggs, and milk. Animal proteins are selected because there is good reason, both on experimental and clinical grounds, for believing that they have a very special value in the treatment of tuberculosis. The experimental researches of Richet and Héricourt many years ago, confirmed by the author and others, proved conclusively that meat, administered in the uncooked form, had a specially beneficial effect in tuberculosis. Their observations further showed that the specific effect lay in the juices of the meat rather than in the fibre. The explanation of this special value is, I believe, to be found, in great part, in the special influence of a diet rich in proteins on the thyroid gland, as shown in recent years by the results of the author's experimental researches. Be that as it may, there is no question of the special value of animal proteins in the dietetic

treatment of tuberculosis, and more especially of meat, eggs, and pure milk administered uncooked.

Like the proteins, the fats should be increased by about one-third of the normal for a non-tuberculous subject, this being obtained from butter, cream, yolk of eggs, and milk. There is no occasion to increase the farinaceous foods; any excess of starchy foods, over and above that obtaining in a normal dietary, is not called for, and is better avoided because of the risk of inducing abnormal fermentative changes.

It should be noted that any increase in the protein, over and above the third referred to, is not associated with any better clinical results, and the extra protein is immediately excreted, throwing a considerable strain on the kidneys, in some cases inducing albuminuria. In all cases, the urine should be examined carefully from time to time.

From the outset, the patient must be impressed with the fact that the diet is of primary importance in the treatment of the disease, and the appropriate diet must be kept up so long as the condition is present. Directions should not be given in a general way, but should be detailed, special mention being made of the food to be eaten and the food to be avoided. The hours for taking food and the amount to be taken should be outlined carefully. It is usually advisable to give detailed written instructions on the subject.

The diet should be restricted to three good meals a day, with two snacks at suitably separated intervals. Thus, if breakfast be at 8 a.m., lunch at 1 p.m., and dinner at 7.30, a light snack may be given at 11 and at 4. It is inadvisable to allow extras of any kind between meals. In some cases, indeed, when very hearty meals are taken, the snacks can be dispensed with. If the patient sleep well, it is better not to give anything by night. If wakeful, a cup of beef-tea or diluted warm milk may be allowed through the night. The food must be prepared nicely, served daintily, and varied as much as possible. It is not, as a rule, advisable to give much fluid at meal times. Where the extra nourishment required is given in the form of milk, not more than one tumblerful should be given with meals. It is noteworthy that a patient, in the most favourable conditions of fresh air and sunlight, may be able to digest and assimilate an extra diet of 6 to 8 raw eggs daily, whereas under less favourable

conditions in a town, not more than one or two eggs daily can be taken without deranging the digestion.

A typical dietary framed for an average case of fair digestive capacity, and free from complications, is here given. A choice is given for the chief courses in the menu. It will be observed that the diet contains a restricted amount of bread, breadstuffs, suet puddings and the like, which predispose to abnormal fermentative processes.

8 a.m. *Breakfast*.—Coffee, cocoa, or tea, made mainly with milk—two breakfast cups. One of the following:—Egg, plain boiled, scrambled or poached—one or two. Bacon, ham, tongue, herring or fish, meat rissoles. Toast, two or three half slices; roll or oatcake; plentiful supply of butter.

11 a.m.—Milk, $\frac{1}{2}$ pint, to which may be added 1 or 2 raw eggs.

1.30 p.m. *Lunch*.—Fish or entrée, an ordinary helping. Meat—roast, grilled steak, or chop (rather underdone), and vegetable. Custards, curds, stewed fruit and cream, soufflés, or omelets. Milk, $\frac{1}{2}$ pint.

4 p.m.—Cup of tea with cream, bread and butter, slice of cake.

7 p.m. *Dinner*.—Soup about 8 ozs. of clear consommé. Fish or entrée. Meat and vegetable. Pudding, savoury, or biscuits and cheese. Milk, $\frac{1}{2}$ pint.

With any tendency to sleeplessness, a cup of clear soup is of special value, or a glass of hot milk taken at bedtime. If the custom of the patient is to take the chief meal of the day at midday, and a late meat tea, the evening meal may be as follows:—Fish or egg. Meat, ham, sausage, or brawn. Cold sweet—such as cornflour shape, custard or stewed fruit. Milk, $\frac{1}{2}$ pint, flavoured with cocoa or coffee. Biscuits, butter and cheese.

TUBERCULOSIS IN CASES WITH IMPAIRED DIGESTION.

Anorexia, nausea, and a general impairment of the digestive functions are prominent symptoms in many cases of tuberculosis, and are frequently present in the early stages of the disease. The best treatment for these conditions, is to place the patient under good hygienic conditions with rest, con-

tinuous supply of fresh air and sunlight, and at the same time give the generous diet above laid down. As a rule, this results in a striking improvement in appetite, the patient soon acquiring the ability to digest and enjoy the food. In not a few cases, however, the patient is unable to take the large meals necessary on account of the indigestion set up. The meals have then to be presented in a less bulky form, but still containing the necessary increase of protein, given in the most easily digested form. To effect this, all foodstuffs having a large bulk and small nutritive value must be eliminated from the diet—viz., potatoes, green vegetables, porridge, bread, suet puddings, other foods of equal nutritive value but smaller bulk being given. This is done by increasing the amount of animal foods, e.g., raw-meat rissoles, mince, steak, or milk may be fortified by the addition of soluble casein preparations, such as plasmon or protein. As much as 1 to $1\frac{1}{2}$ ounces of these preparations can be given, and as one teaspoonful of plasmon is equivalent in protein value to 2 pints of milk, its value is obvious. Casein preparations are best added to soup or milk puddings: plasmon bread and plasmon biscuits can be bought ready made. Eggs may be added to milk or soup, thus providing extra nourishment with little extra bulk. One quarter of a lb. of scraped beef can easily be added to a small cup of beef soup, or $\frac{1}{2}$ lb. of scraped meat made into sandwiches with tomatoes is an easy method for some patients to take the extra nourishment. Cream and yolk of eggs are the best means of supplying the necessary fat, but at the outset their administration requires care.

In some cases a fluid diet largely made up of milk is essential for a time, and in others a dietary largely of meat is best adapted for the enfeebled state of the digestive tract. Examples of these two dietaries, with hours of administration, are here given.

Fluid Dietary, mainly Milk.—This is advisable when the anorexia is persistent and severe. In place of giving the usual three meals and two snacks in the 24 hours, it is advisable to feed oftener and in smaller amounts; also, if the patient is wakeful, to give nourishment in the course of the night.

7 a.m.—Milk, $\frac{1}{2}$ pint.

8.30 a.m.—Milk, $\frac{1}{2}$ pint, with casein, $\frac{1}{2}$ oz., flavoured with coffee or cocoa. Gruel made with milk, and eaten with cream.

11 a.m.—Soup, thickened with $\frac{1}{4}$ lb. raw beef, scraped; or soup, thickened with egg and cream; or milk with egg.

1 p.m.—Chicken essence, or veal jelly, strengthened with casein, $\frac{1}{2}$ oz., and milk, $\frac{1}{2}$ pint; or raw meat mince, $\frac{1}{4}$ lb., with milk; or raw-meat rissoles, with milk; or raw-meat sandwiches, with milk.

3 p.m.—Milk, with egg, or thin custard.

5 p.m.—Milk tea, $\frac{1}{2}$ pint, with cream.

7 p.m.—A meat juice, *e.g.*, Wyeth's, Leube Rosenthal's meat solutions, mixed with port or Burgundy; or soup, with raw meat; or beef extract, with egg and milk, forming a custard; or milk and arrowroot, with casein and cream, $\frac{1}{2}$ pint (brandy may be added).

8 p.m.—An invalid food, made with milk and casein, $\frac{1}{2}$ pint.

11 p.m.—Milk and egg, or chicken tea with egg.

In very severe cases, the milk may have to be peptonized or pancreatized, or fermented milk (koumiss or kephir) is sometimes tolerated when ordinary milk causes digestive disturbances; whey, also, flavoured with sherry and fortified with casein and cream.

A largely Meat Dietary.—This is often of great assistance for a time in cases in which dyspeptic symptoms follow the large mixed meals.

6 a.m.—Milk, $\frac{1}{2}$ pint.

8 a.m.—Milk, 1 pint, fortified with casein, $\frac{1}{2}$ oz., flavoured with coffee or cocoa (peptonized). Slice of toast with butter. Bacon, ham, eggs, fish, meat rissoles, or steak (taking two things).

11 a.m.—Glass of hot milk, with eggs, or raw meat soup.

1 p.m.—*Lunch.*—Soup from strong stock, or fish soup, or helping of fish. Mince, lightly grilled tender steak or chop, or slice of underdone sirloin of beef, or roast leg of mutton. Stewed fruit and custard, or jelly with cream. Toast, glass

of milk.

4 p.m.—Cup of milk-tea, toast and butter, or biscuit and butter.

Dinner.—Much the same as lunch. A little wine.

Intermediate Diets.—It is advisable occasionally to stop this largely meat dietary for a day or so, and give other foods, *e.g.*, egg, fish, a little farinaceous food, and vegetables, just for a change. This gives the kidneys a rest, and diminishes the risk of the development of albuminuria or other urinary trouble arising out of the large protein diet.

DIET SUITABLE FOR THE WELL-TO-DO CLASSES.

The extra nourishment required can be given either in the form of 3 pints of milk extra daily, or 2 to 3 raw eggs and 2 pints of milk, or as underdone red meat 6 to 8 ounces. More commonly it is supplied by a judicious combination of these foods. The eggs may be taken raw, or added to milk or soup, or $\frac{1}{2}$ lb. raw meat, or meat mince may be added to the daily dietary. Gelatine is a most useful form of protein. It can be given in the form of stock made with young bones, *e.g.*, knuckle of veal, chicken or calf's foot, which when boiled form a good jelly, and can be used as an excellent stock for soup. It can also be given in the form of jellies, creams, or blanc-manges.

DIET AMONGST THE WORKING CLASSES.

Here the extra proteins required may be got from the cheaper meats and fish, from skimmed milk, and from the pulses. The extra fat may be obtained in the form of margarine. Economy is effected by buying the cheaper meats at 5d. and 8d. per lb., including the best foreign meat, and by making more use of oatmeal, dried peas, beans, and lentils, and the cheaper forms of cheese (Dutch and American). The following gives a rough idea as to how the meals can be arranged satisfactorily and the amounts of the various foods required, the cost working out under 1s. per day.

Breakfast.—Half pint of porridge, with milk and sugar, a rasher of bacon or a herring, a round of bread, tea or coffee.

Dinner.—Two large chops or a large plateful of meat, with potatoes, a teacupful of milk pudding, or a large slice of suet pudding, half a round of bread, and a glass of milk.

Tea.—Two to three rounds of bread and butter with jam.

Supper.—Half pint of pea, bean, or lentil soup, or half pint of porridge; two rounds of bread with cheese, a glass of milk.

PROPHYLACTIC TREATMENT FOR CHILDREN OF TUBERCULOUS TENDENCY.

In children, in whom there is a marked tendency to tuberculous disease, the question of diet is a highly important one, as much can be done to eradicate the tendency. The writer has had under his care many delicate children of decidedly tuberculous tendency, whose constitutions have apparently been benefited profoundly by means of the administration of an appropriate dietary continued for six to twelve months or more. Such children can be observed to put on weight in the form of muscle and fat, to lose their pallid, delicate appearance, and to acquire the physique and general characteristics commonly associated with the gouty diathesis. The special feature of the diet in these cases is the necessity of an increased amount of animal protein food, more especially meat or raw-meat mince. The following diet sheet is adapted for a child of 5 or 6 years of age with a strong hereditary tendency to tuberculosis.

Diet for a Child of 5 years, of tuberculous stock.—This dietary should contain a more liberal supply of animal proteins in the form of meat, eggs, milk, and soup, than an ordinary diet, the diet including two pints of milk, and meat foods at least three times daily. A diet along the following lines should be insisted on and continued during the growing period.

6.30 a.m.—Milk, biscuit and butter.

Breakfast.—Egg, fish, or bacon, with bread, butter and milk.

Dinner.—A three course dinner comprising:—(a) soup always made from meat stock and sometimes containing raw meat; (b) a meat course, such as pounded meat and vegetables, fish with sauce and potato, chicken or rabbit; (c) a pudding, chiefly of proteins, cream, custard baked or boiled, blanchmange (made with milk and cream), jellies, with fruit and cream, (d) a glass of milk.

Tea.—Milk, bread and butter.

Supper.—Good meat soup thickened with milk; or egg or meat purée or lentil purée.

USE AND ABUSE OF DRUGS IN TUBERCULOSIS.

By PROF. W. E. DIXON, M.A., M.D., F.R.S.

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IT is a matter of common knowledge that a patient suffering from phthisis who, for the first time, is placed under the charge of a medical practitioner, will, for a time at least, improve in health, no matter what drugs, vaccines, or speciality of treatment may be employed. The beneficial result is due in this, as in many other diseases, to efficient nursing, to the regulation of food, exercise, and sleep, and possibly to a more open-air life. If only this effect were clearly recognized, the number of "treatments" in vogue for this common disease might be diminished. For we are all more inclined to regard an improvement, in the patients under our control, as being the result of our interference with their physiological functions through the agency of drugs, sera, vaccines, or other active treatment adopted, than of the improved conditions under which they are placed. General hygienic measures are of primary importance in treatment, and it is not until all the beneficial effects, which we know will ensue from these alone, have been exhausted, that we have any right to ascribe an effect, beneficent or otherwise, to a special treatment.

Drugs are employed in phthisis, either with the object of attacking and preventing the growth of the tubercle bacillus or other organisms with which the disease may be associated, or of neutralizing poisonous toxins, or of removing or relieving symptoms. In the first group, the drugs which are employed to influence the disease directly are, for the most part, derived either from coal-tar derivatives or the essential oils; curiously enough, both groups of drugs are built up on the same general plan, and consist of the benzene nucleus with one or more side chains.

There are few diseases for which so many systems of

cure have been introduced as tuberculosis. All these systems, when examined, are found to be based on the supposition that it is possible to destroy or prevent the growth of the tubercle bacillus in the body. It is well known that it is not possible, by the administration of drugs by the mouth, to obtain a sufficient concentration in the tissues to destroy living bacteria, because the tissue-cells succumb to most antiseptic drugs a little before the bacteria; but it may be possible to increase the activity of the tissues and thus help to destroy the bacteria, or to weaken the resistance of the bacteria and so render their destruction by the tissue-cells easier. The therapist should always remember that the golden rule of treatment is rest for the diseased organ, and that some conditions in disease, such as the febrile state and coughing, may be the best for the patient under the circumstances, and may represent the natural reaction of the body to facilitate the destruction of the micro-organisms, or to clear the chest of putrid material respectively.

Cinnamic acid and its salts and derivatives were very largely used, especially abroad, a few years back as a specific



Cinnamic acid, of which the sodium salt is "hetol."

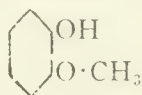
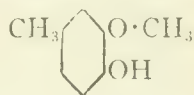


Ortho-coumaric acid, of which the acetyl derivative is "tylmarin."

for phthisis, and the most roseate complexion was put on this treatment. It came into use because it had been found, experimentally, that cinnamates and coumarates cause polymorphonuclear leucocytosis only when injected under the skin, though what benefit is likely to be derived by altering the distribution of leucocytes in the body, and attracting them from the lungs and bone marrow into the general circulation, is not clear; there is evidence, however, to show that antibody formation is increased. Cinnamates given by the mouth do not alter the distribution of the leucocytes. Sodium cinnamate (hetol) is best given by intramuscular injection, from 1 to 4 c.c. of a 10 per cent. solution being given for

a dose ; but it is well not to repeat this more frequently than once or twice a week. The acetyl derivative of coumaric acid is sometimes taken by the mouth during the injection period, twice or three times daily. Reports on this treatment are distinctly favourable, but probably not more so than the results obtained by the modern sanatorium treatment without the use of drugs. In nearly all the reported cases, it is impossible to decide what benefit to the patient should be ascribed to the general treatment, and what to the drug.

Creosote is obtained from wood tar, preferably beech wood, since the tar from this contains a smaller amount of irritating cresols ; it consists of a mixture of guaiacol, creosol, and small quantities of other phenols such as cresol. These bodies are

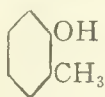
*Guaiacol.**Creosol.*

excreted mainly by the kidneys, but a small amount is excreted by the lungs. If creosote is administered to patients, especially those with putrid and plentiful expectoration, it sweetens the sputum and diminishes its amount. It is, therefore, regarded as especially valuable in the so-called mixed infections, but a critical examination of the literature shows that it can, in no sense, be regarded as specific for the tubercle bacillus. One objection to this drug, and indeed to almost all benzenoid derivatives, is their tendency to derange digestion. It is commonly administered in capsules, in doses of 2 or 3 minims. The best results have been obtained by inhalation ; for this purpose, a mixture of creosote and phenol with spirits of chloroform, in equal parts, is as good as any. Creosote carbonate (creosotal) has the advantage that it is less likely to derange digestion than creosote ; when administered by the mouth, it breaks up slowly in the intestine, and creosote is set free.

Guaiacol is largely used as a substitute for creosote, but it is insoluble in water, has an objectionable taste, and is irritant to the stomach. It is advisable, then, to employ one of its salts, of which, perhaps, the three best known are the carbonate, cinnamate (styracol), and the potassium sulphonate

(thiocol), all of which have been said to liberate guaiacol in the body; the cinnamate is best because the greatest percentage of guaiacol is liberated, and thiocol has the feeblest action, being excreted unchanged. The salts of guaiacol are best administered in cachet.

Creosote also contains cresols, which are excellent germicides, but somewhat more irritant than guaiacol. They can



Ortho-Cresol.

be brought into suspension by soap, as in creolin and lysol. Izal is a milky fluid of similar constitution, and cyllin is an improved creolin. Some of these, on account of their irritant properties, are unsuitable for internal administration, but some of the less irritant, like izal, have been used as substitutes for the more expensive creosote and guaiacol, and are said to produce the best results in active pulmonary tuberculosis with abundant foetid expectoration.

Pix liquida (wood-tar) contains guaiacols, cresols, and many other substances. It is used in much the same way as creosote, to diminish expectoration, allay cough, and sweeten the bronchial secretions in mixed infection; the most suitable form of administration is syrupus picis liquidæ.

The drugs that have been mentioned are probably the best and most typical of the benzenoid series, and numerous reports on their action in phthisical patients show that they have an influence for good; they are usually stated to increase the appetite, improve nutrition, and diminish the amount of expectoration. Without doubt, they diminish the number of pathogenic micro-organisms to be found in the sputum, and in favourable cases will convert a mixed infection into a simple tuberculosis.

Formic Aldehyde is only slightly poisonous to mammals, yet as a germicide it is as effective as perchloride of mercury, and it has the great advantage of volatility, which increases its penetrating power into tissue-cells. It has been employed in two forms for the treatment of phthisis. First, as a vapour: the patient is placed in a closed room on a couch, and the

gas is liberated by placing formaline tablets on a tray over a spirit lamp; with this method some irritation of the broncho-nasal mucous membrane ensues, but it is not of serious moment and soon passes off; the inhalation should be continued for an hour or two; or the formaline may be administered on an inhaler, or in the form of a fine spray, both of which methods should be employed for several hours daily.

The second method of using this antiseptic is by intravenous injection; for this purpose a 0.05 per cent. solution of the gas in normal saline may be injected, and as much as 50 c.c. of this solution can be administered daily. Formic aldehyde is excreted mainly by the kidneys, and after poisonous doses albuminuria, hæmaturia, and even coma have been described, so that it is necessary to go to work carefully; some is also excreted by the lungs.

It may be pointed out here that individual tubercles are said to be avascular, and that drugs may have difficulty in reaching them, and no doubt this is to some extent true; nevertheless, we know that drugs move easily by diffusion into avascular tissues, and so this fact alone in no way invalidates drug treatment.

Marvellous cures are reported by using both methods of treatment; the number of tubercle bacilli is said to diminish, the fever to disappear, the cough to improve, and the expectoration to become less, and especially is the improvement marked in mixed infections. As in all the recorded cases, these treatments were combined with the routine treatment, it is not easy to determine what benefit should be ascribed to the routine method, and what to the formaldehyde. A few physicians have been unable to satisfy themselves as to any benefit by this treatment.

SPECIFIC TREATMENT BY METALS.

Vanadic acid and its derivatives were introduced into therapeutics on the supposition that they could act as oxygen carriers, and so destroy putrefying organic matter, take effect as antiseptics, and favourably influence tissue respiration. This premise is entirely speculative, and is based on no physiological fact. Sodium metavanadate, the form in which the drug is usually administered, is given twice or three times daily, commencing with doses of $\frac{1}{30}$ th of a grain after food

for about a week, followed by a period of rest. As a result of the treatment, the usual beneficial effects are described, especially in early phthisis. Vanadic salts possess the general pharmacological characteristics of all the metallic salts, the most pronounced action being an intense vaso-constriction in the splanchnic area. I can find no real evidence that their action is different from the effect, say, of small doses of mercury; and certainly they exert no specific action in phthisis.

The emanations of thorium nitrate are sometimes inhaled, the procedure is as follows:—A solution of thorium nitrate (1 in 5) is neutralized with ammonia, and allowed to stand in a bottle $\frac{2}{3}$ ths full; the emanation which accumulates in the vessel is inhaled. The treatment is entirely speculative, and, at present, only in an experimental stage.

Mercury has been employed principally as the succinimide, hypodermic injections of a fifth or a quarter of a grain being administered to the tuberculous patient every alternate day. It is best given in a 4 per cent. solution, with 2 per cent. cocaine added to diminish pain, which always attends these injections. The results of this treatment are, to my mind, not sufficiently striking to warrant its continued employment, although, of course, several observers have recorded their belief in its efficacy.

Laryngeal phthisis is said to be prevented by the inhalation of the steam rising from boiling water which contains corrosive sublimate 1 in 10,000 parts; but if this procedure is adopted it is well first to use a spray of cocaine.

ESSENTIAL OILS.

These form another important group of drugs, many members of which are very largely employed in the cure or relief of phthisis. These oils contain one or more terpenes, which all possess a cymene nucleus.



From this nucleus it will readily be understood how closely these bodies are related to some of the coal and wood-tar products, which have been mentioned already. They are excellent antiseptics, and possess great power of penetration on account of their volatility. Essential oils are excreted partly by the bronchial mucous membrane, and their odour is in many instances readily appreciated in the breath.

Terebene, terpene hydrate, *oleum terebinthinæ*, and *oleum pini*, drugs which are all closely related to one another, are largely prescribed to limit expectoration and retard putrefaction in the lungs in mixed phthisical infections. Many observers state that they also diminish the number of tubercle bacilli in the expectoration. One objection to all essential oils is, that in large doses they may give rise to albuminuria and hæmaturia; an important effect, as it prevents the drug being pushed. They are best administered in capsule or in an emulsion, but many physicians think that good results can only be obtained when they are employed as an inhalation with hot water.

Eugenol is a terpene found in several essential oils, such as oil of cloves; it has the antiseptic properties of the other essential oils, but it is almost non-irritant and non-toxic. Oil of cloves and eugenol are stated to be very efficacious in phthisis. In numerous records, the expectoration, cough, and fever have been reduced after doses of 3 to 5 minims given two or three times daily.

Oil of cinnamon is taken, both internally in large doses, such as 10 minims, and by inhalation, 30 minims in a pint of hot water, in the treatment of phthisis. It owes its activity to cinnamic aldehyde, which is converted into cinnamic and benzoic acids in the body, as well as to eugenol and other terpenes; it is one of the least irritant of these oils. Oil of eucalyptol is yet another essential oil which has been credited with a specific action in various fevers, including phthisis. It differs little in its effects from most other non-irritant oils, and, like them, is best administered either in a capsule or by the inhalation of the vapour. *Oleum allii* (oil of garlic) differs a little from the others in that it owes some of its activity to allyl sulphide, besides the volatile terpenes it contains. Wonderful cures have been described

by dosing with this oil, or with the allyl sulphide, but, as in the case of all these specifics, they fail in the hands of the sceptical physician. Allyl sulphide should not be given pure, as, on account of its irritant properties, it may produce vomiting and purging.

The balsams form the last group of oils which need mention, and they contain besides terpene, cinnamic, or benzoic acids, or both. Friar's Balsam is perhaps the most ancient of these, but possesses no special advantages over the balsams of Peru and Tolu; they are non-irritant, and valuable as pulmonary antiseptics, but possess no special advantages over the other non-irritant volatile oils.

It seems clear from the literature that the use of essential oils in phthisis may be invaluable. They relieve cough, diminish the amount of expectoration, and may also diminish the number of tubercle bacilli in the sputum. Moreover, a considerable number of clear cases are recorded in which they have converted a mixed infection with foul-smelling expectoration into the simple tuberculous condition. They should be administered either by the mouth, by inhalation, or by both methods. It is not a matter of great importance which of these oils is employed. The oils of allium, eucalyptol, turpentine, cloves, cinnamon, and the balsams are all useful.

Nucleins, which are generally prepared from yeast, have been credited, though really without any valid evidence, with the power of neutralizing toxins in the blood. The injection of nuclein or nucleinic acid in tuberculosis is stated to produce a reaction similar to that of tuberculin, and to increase the opsonic index. The effect of small injections in man is to cause, first, a disappearance of the leucocytes from the peripheral circulation for a period of from four to six hours; then, they reassemble in increasing numbers, and the ultimate hyper-leucocytosis will exceed by two or three times the normal numbers, and remain for two days. Nucleins taken by the mouth have no such action, and do not differ from yeast, which was official in the 1885 Pharmacopœia. Nuclein is best administered as a 5 per cent. solution of sodium nucleinate, of which 1 c.c. is the usual amount for an hypodermic injection. The amount of reliable evidence as to the value of this treatment is not such as will permit

of any definite conclusions being drawn at present.

ANTIPYRETIC DRUGS.

It is now generally recognized that drugs administered with the object of reducing the temperature are better avoided, except in certain unusual circumstances, because we know that the condition of the patient which induces fever is the best for him under those circumstances, and that the rise of temperature puts him into a stronger position to withstand disease. Nevertheless, under certain circumstances it may be desirable to reduce the temperature to a lower level, and in these cases drugs are employed which affect the heat centres in the basal ganglia of the brain, and increase the total heat loss by dilating the skin vessels and increasing sweating. Phenacetin is a typical example of such a drug, and its administration in full doses may be relied upon to cause a depression in the high evening temperatures of the tuberculous by a degree or two. Pyramidon in 3-grain doses every four hours is another antipyretic, much extolled by German physicians for use in general tuberculosis; it is apt to cause excessive sweating. Cryogenin, maretin, and cello-tropin, and numerous other drugs have been employed also with the same object, none are without objectionable effects, and I do not think the evidence shows that they are superior to phenacetin. One objection to all these drugs is that they depress the morning temperature beyond that usual for the patient. Antipyretic drugs are no longer employed as specifics, but as palliatives.

Remedies which have fallen into disuse are so numerous, that two or three will be sufficient to serve as examples. Sodium fluoride was at one time given internally and by hypodermic injection, and the fumes of the mixed acid were inhaled. It has fallen deservedly into disrepute, one reason being that the fluorides are among the most irritant and destructive drugs known, and their use is always attended with danger. Cantharidates were suggested by the late Professor Lebreich, who believed that, if the sodium salt were injected under the skin, it would set up inflammation in the tuberculous area and bring about a cure. The treatment is not free from danger on account of the renal irritation, which may be induced, and the results are so doubtful that the method is

no longer employed. Urea is another substance which was at one time given largely to phthisical patients, for no other reason than that phthisis is rare in the gouty, which is, of course, no reason. This method is justly a thing of the past.

DRUGS USED FOR GENERAL OR TONIC PURPOSES.

Of remedies employed in phthisis in the nature of foods, cod-liver oil usually holds the first place. It differs chemically from other oils and fats, in that it is composed almost entirely of unsaturated fatty acids in the form of glycerides, together with traces of secondary products, possibly the result of putrefaction in the livers. From experimental evidence, it is extremely probable that one function of the liver is the preparation of fatty acids of a high degree of unsaturation for the further processes of metabolism, and, if this is so, it might well be expected that cod-liver oil would have some action on metabolism different from that of other fats. Williams has shown that the administration of this oil increases not only the total absorption of fat, as of course it should, but also the percentage absorption of all fats taken, and further, that it influences the retention of nitrogen favourably. Cod-liver oil is clearly, then, a different kind of food from other fats, such as cream and butter, and when general metabolism is abnormal it may supply a deficiency.

Besides this action, it has been shown also that cod-liver oil *in vitro* dissolves the fatty envelope which surrounds the tubercle bacilli, and retards the growth of the organism. The value of cod-liver oil in phthisis has been extolled by almost every writer for the last 55 years, and clinical opinion is practically unanimous that it is one of the essentials in the satisfactory treatment of consumption. Few physicians have observed any considerable number of phthisical patients to whom this remedy was not administered. While, then, it is undoubtedly useful in the treatment of all wasting diseases, and especially phthisis, no evidence exists that it exerts any specific action on the tubercle bacillus in cases of well-developed and rapid tuberculosis.

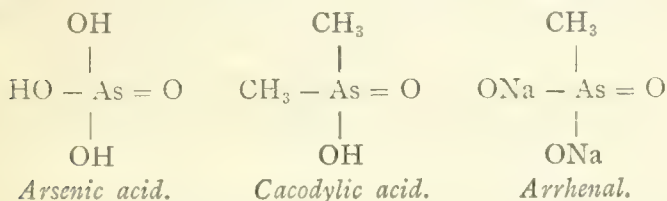
Malt extract, which is occasionally employed as a substitute for cod-liver oil, consists of 50 or 60 per cent. of maltose, with dextrin, dextrose, and diastase. Its medicinal value depends upon its carbohydrates and its diastatic action,

but it cannot be regarded as a true substitute for cod-liver oil. Lævulose is sweeter and more easily assimilated than cane sugar, and has been suggested as a food in phthisis in such large doses as four to eight ounces daily.

Numerous phosphorus compounds have been recommended on the supposition that they supply the necessary materials for the manufacture of lecithin, which forms such a large part of nervous tissue; the use of these has been advocated in wasting diseases and phthisis, although we have no evidence that a deficiency in phosphorus compounds is present in this disease. But an objection, even more serious than this, is the fact that inorganic phosphates can be absorbed at least as readily as the organic forms. Glycerophosphates are such organic phosphorus compounds, and were introduced because it is in this form that phosphorus occurs in lecithin; they are sometimes given as simple compounds, and sometimes combined with organic bases, as in Sanatogen, which is a compound of calcium glycerophosphate with casein. This reasoning is, of course, fallacious: it presupposes that glycerophosphates are absorbed as such. Such valid evidence as we have fails to offer any support to this view, and glycerophosphates are almost certainly absorbed as inorganic phosphates, or at least such portion of them that is not excreted unchanged by the rectum. It has been shown that during a diet rich in phosphorus, such as eggs or sweetbread, the administration of either organic or inorganic phosphorus compounds produces no marked effect on protein metabolism. The facts suggest that no advantage is to be gained over inorganic phosphates by the administration of organic.

Tonic treatment by such drugs as the hypophosphites, arsenic, iron, quinine and calcium, or the bitters are often adopted as a matter of routine. For the hypophosphites, I have no good word; they are excreted by the kidneys unchanged and exert a mild salt action. Hypophosphites were introduced as a substitute for phosphorus, but have no phosphorus action: besides being useless they are expensive. Quinine retards protein breakdown, and it may be prescribed with advantage in many wasting diseases. Arsenic is another drug which influences metabolism, but which acts entirely differently from quinine, in that it interferes with carbohydrate metabolism, so that after the exhibition of small

medicinal doses fat is laid on especially in the subcutaneous regions. Arsenic also has a favourable influence on growth, as shown especially by its effect on the growth of bones in the young. To avoid gastric irritation, French physicians often use the cacodylates, arrhenal or other organic compounds, which are very much less toxic, but produce a mild degree of arsenical action over a more prolonged period.



The compounds themselves are quite non-poisonous, but a small amount is broken up in the body, and it is this which exerts the arsenical action.

SYMPTOMATIC TREATMENT.

The various drugs employed in the relief of the untoward and useless symptoms of phthisis require only very brief reference. Perhaps the commonest is the hacking, useless, dry cough, and especially the disturbing night cough. Numerous remedies have been employed; sodium bicarbonate is sometimes useful, it renders the bronchial secretion slightly more alkaline, and so tends to dissolve the tough mucus. Hydrocyanic acid is also said to be beneficial, though its action cannot be powerful. Strong hydrofluoric acid diluted five times has been used as an inhalation, but it is necessary to protect the eyes well from the vapour. The important drug for this purpose is, of course, one of the morphine derivatives, which act by depressing the nerve cells in the medulla connected with the afferent fibres from the bronchioles. Codeine is regarded as superior to morphine, because, whilst it stops coughing equally well, it does not render the respiration more shallow, like morphine, though it slows the rate: also codeine does not produce the same degree of constipation as morphine. Heroin, peronine, and dionine, all derivatives of morphine, have no advantages over codeine.

The night-sweating may be limited or stopped by numerous

remedies. Zinc oxide has obtained some reputation; if it really has an action it is difficult to see how it is produced, since it is not absorbed. Camphoric acid and agaricin are more efficient, they act apparently by depressing the nerve-endings to the sweat glands; a preparation of opium is frequently administered along with the latter drug on account of its purgative action. Picrotoxin was used at one time for the same purpose, but it was inefficient and dangerous, and is now discarded. Atropine is the drug upon which it is always possible to rely; a hundredth to a fiftieth of a grain at bedtime will depress the nerve-endings to the glands to a degree sufficient to make sweating impossible.

So much has been written on hæmoptysis that a few words must suffice. The object of treatment should be to facilitate clotting of the blood and keep the blood-pressure as low as possible. Physical and mental efforts are the principal causes of sudden rise in blood-pressure, for which rest in bed and morphine by injection should be prescribed respectively; further treatment is not likely to be required. The time taken for the blood to clot under constant conditions in a healthy man cannot be altered by the administration of calcium salts by the mouth, but is certainly influenced when these are given subcutaneously or intramuscularly; in both cases, the rate of clotting is made distinctly quicker. The effect of the calcium treatment is sometimes most decided in patients in whom the bleeding is more or less continuous; after the injection the hæmorrhage should stop within a minute or two. The use of adrenalin, ergot, lead, and other drugs, which raise blood-pressure, can only be harmful, for even supposing that they constricted the pulmonary vessels to a trifling degree, the rise in blood-pressure would far and away overshadow any beneficial effect which might accrue from the vaso-constriction.

The diarrhoea of phthisis calls for no special comment, the routine treatment is generally sufficient. Salol, peroxide of magnesium, the lactic acid bacillus, and methylene blue are a few of the varied measures which have been adopted, but our reliance should be placed rather on bismuth, one of the preparations containing tannic acid, like kino, catechu, or logwood, and, if necessary, opium.

TUBERCULOSIS AND PHOSPHORUS METABOLISM.

By JOHN ALCINDOR, M.B.

THE treatment of tuberculosis presents a very difficult problem to the medical practitioner; success in raising the standard of physiological life would certainly result in enhanced resistance to the disease.

Carbon, hydrogen, nitrogen, and oxygen constitute the essential elements of protoplasm; sodium, potassium, calcium, magnesium, iron, sulphur, chlorine and fluorine enter into combination with this colloid substance for the elaboration and differentiation of the tissues of which the organism is composed. Phosphorus, by virtue of its chemical properties, occupies a peculiar position in the animal economy.

One finds that it is the most highly oxidizable substance known to science. Physiologists have shown that it is present in all the tissues of the body, it occurs as phosphates in the supporting structures, and in combination with proteid matter forming proximate principles known as nucleo-proteid or nuclein, which is the most abundant nitrogenous compound found in protoplasm, nervous tissue, muscle, blood corpuscle, the spermatid fluid, the egg and roe of fishes; all of which are replete with potential activities. Schäfer¹ estimated that, of the total solids in leucocytes, 68 per cent. consisted of nuclein with 3.01 of phosphorus. Frick,² in estimating the phosphorus in the blood of four tuberculous patients in the early stage of the disease, found .351 parts as the maximum, .197 the minimum, and .291 as mean, whereas in normal blood he found .874 parts per 1,000.

Phosphorus initiates and promotes among the bioplasmic elements oxidation of the tissues, which is the primordial phenomenon of vitality, with consequent integration and disintegration, and elimination of effete products; in normal conditions, integration far out-distances disintegration; growth results, together with the development of the natural protective powers of the body, the phagocytes, the opsonins and,

when invaded by micro-organisms, the antibodies. Should there be any interference with efficient oxidation, such as an insufficient intake of phosphorus in oxidizable and assimilable form, which is derived mainly from a nitrogenous diet, or a breaking down of the nucleins from any cause whatsoever, the result is lowered vitality, the end-phenomenon of all the predisposing factors in tuberculosis.

It would appear that the rational method of treating and curing tuberculosis would be to arrest the depletion of phosphorus, and to provide fresh supplies when there is a deficiency. With this principle underlying the problem, the author tried the effect of various salts of hypophosphorous acid, and, after a considerable number of trials, arrived at the conclusion that sodium hypophosphite in doses of grains x-xx, given three times a day for an average period of six months, would arrest the disease in the early stage, and would produce marked improvement in moderately advanced cases, thus prolonging the expectation of life. The potassium and calcium salts are not so useful in their general effects.

During the course of treatment, it was found advantageous to attend to the frequent chills, coughs, and other complications to which the consumptive is so peculiarly susceptible; sodium salicylate, potassium acetate, ammonium carbonate, vin. ipecac., magnesium carbonate, and a few other ordinary drugs were requisitioned for the purpose. Substantial and nutritious fare, especially of a nitrogenous nature, was prescribed for those with good digestion. Suggestions with regard to hygiene were made; tuberculin, cod-liver oil, and alcohol were not employed. The treatment was carried out at the patients' own homes; a large proportion of them belonged to the working class, continued, while under the influence of the hypophosphites at their work, and made steady progress in spite of that fact.

CASES.

(1) A. C., æt. 16, factory hand, complained of debility, emaciation, sweating, cough, dyspnœa, copious expectoration. On physical examination, flattening of left chest with cavity down to fourth rib and crepitant râles. After three months' treatment, cough improved, sweating ceased, râles disappeared. Six months later, there was consolidation of practically

the whole of the left lung, with crepitations and rhonchi all over the pulmonary area, extreme prostration, and copious expectoration teeming with T.B. After four months' further treatment, the greater part of the consolidation disappeared, with improvement in the symptom-complex. The treatment was again discontinued, and patient died six months later.

(2) G. B., æt. 7, suffered from debility, anorexia, furred tongue, sweating, cough with copious expectoration, in which T.B. were not found in the only examination carried out. There were general signs of severe bronchitis, but prostration deepened and emaciation progressed rapidly, and tuberculosis was diagnosed. 20 grs. of sod. hypophosph. with a stimulating expectorant were given every four hours. After two months' treatment, the course of the disease was stayed; physical examination revealed cavities at both apices, another at the apex of the left lower lobe, the base of the left lung was dull on percussion, with increased vocal resonance and fine crepitations, which disappeared in three weeks. Treatment was carried out for seven months, and patient was in perfect health with no sign of active disease eight months later. Patient then contracted measles and bronchitis. He was again placed on the hypophosphites, and made an uneventful recovery. Three years from the commencement of his illness, the patient was in excellent health, though small for his age. Weight, 3 st. 9 lbs. 8 ozs.

(3) R. B., aged 20, in June, 1910, had a severe attack of hæmoptysis, and was taken to a general hospital, where she remained six months, then to an infirmary where she spent four; when seen a fortnight later her condition was as follows:—Slight cough, no expectoration, temperature subnormal, debility, dyspnœa. On physical examination, the whole left upper lobe consolidated, cavernous breathing, numerous crepitant râles and rhonchi, right apex—cavity with few râles—fine râles at bases. Weight, 7 st. Placed on large doses of sod. hypophosph. for two months, with following results:—No cough, dyspnœa less distressing, feeling much better, consolidation less marked, fewer crepitations and rhonchi. Weight, 6 st. 7 lbs. Treatment discontinued and examined a month later, condition practically as when last seen. Weight, 6 st. 8 lbs. Six months later patient was reported as being in good health and at work.

(4) E. P. æt. 22, ill three years with debility, cough, cavity at right apex with coarse rhonchi, left apex dulness with interrupted breathing, little expectoration, which was not examined microscopically. Weight, 9 st. 4 lbs. After three months' treatment improvement in every respect, Weight, 9 st. 9 lbs. Examined twelve months later, cavity at right apex, left apparently normal, in excellent health. Weight, 9 st. 10 lbs.

(5) L. B. æt. 30, complained of pain over both apices, debility, distressing cough, expectoration, in which no T.B. were found. On examination, cavity at right apex with fine râles, posteriorly ditto, left lower apex cavity with râles. Weight, 8 st. 4 lbs., gradually went down to 8 st. 1½ lbs. in a fortnight. Two months' treatment, consisting of 20 grs. of sod. hypophosph. combined with expectorant, followed by 10 grs. of calc. hypophosph. for two months, resulted in loss of apical pain, cough, gain in strength, appetite, etc. Weight, 8 st. 6½ lbs. Examined two years later

cavity at three apices, no signs of active disease, feeling in excellent health. Weight, 9 st. 6½ lbs.—a gain of 14 lbs. after the discontinuance of the treatment.

(6) W., aged 34, right apex disease with probable infiltration of left; usual symptoms. Weight, 9 st. 5 lbs. Three months' treatment, marked general improvement. Weight, 9 st. 8 lbs. Treatment discontinued. Patient grew rapidly worse. Weight, 9 st. Resumption two months later, marked improvement. Weight, 9 st. 4 lbs. 8 ozs. Treatment proceeding.

(7) A. V., complained of pain in right hip, extreme debility and wasting with rigid flexion of the joint for four months, enlarged inguinal glands, ulcer with base attached to right scapula, cough, sweating, and cavity at both apices, confined to bed. Extension-apparatus and large doses of hypophosphites produced excellent results in four months, patient went about wearing an apparatus for six weeks, after which limb was normal and free from pain, no limitation of movement, scapular ulcer healed, was in good health twelve months later.

(8) A. C., æt. 26, spent three months at a sanatorium, which he left in good condition, having gained 1 st. 4 lbs (weight 9 st. 7 lbs). Recrudescence occurred twelve months later, cavity at both apices, with crepitant râles, debility. Weight, 8 st. 3 lbs. Treatment carried out in a desultory fashion, but patient enjoys fairly good health with fair capacity for work.

(9) W. B., æt. 29, complained of cough, shortness of breath, and debility, loss of flesh (over 14 lbs in one year), weight 9 st. 7 lbs. On examination, there was consolidation over the left apex, with interrupted breathing and fine crepitations. Four months' treatment, and examined twenty months later, patient was in excellent health, dry cavity at left apex. Weight, 12 st. 5 lbs.—a gain of 40 lbs.

(10) E. W., aged 7, enlarged glands, palpable on both sides of neck, with right apex disease. Weight, 3 st. 4 lbs. Treatment carried out intermittently for eight months:—Enlarged glands completely disappeared on left side, a few small ones still palpable on right. Cavity on right apex and general health excellent. Weight, 3 st. 6 lbs.

(11) W. L., aged 6, enlarged glands in neck, enlarged tonsils, right apex disease. Weight, 3 st. 5 lbs. Treatment for nine months:—General health greatly improved, glands practically disappeared. Weight, 3 st. 7½ lbs.

(12) A. P., aged 5, large number of small marble-like glands in neck, both apices affected, general health bad. Weight, 2 st. 3 lbs. After six weeks' treatment marked improvement in general health. Weight, 2 st. 6½ lbs. Patient under treatment.

The foregoing are a few selected from a record of about two hundred cases treated during the past three and a half years. It will be noted that a case of phthisis florida, two of the pneumonic type, a number of the incipient and the advanced pulmonary disease were alike benefited, as were the osseous and glandular varieties. Four cases of bone tuberculosis were treated—a child with caries of the spine and pulmonary foci of three years' duration, special hospitals and homes were

tried in vain, when she came under observation the prognosis was very grave, the patient died after six weeks' treatment. A little girl with early signs of hip-joint disease was treated for seven weeks—without extension apparatus—with decided benefit, taken to hospital without the writer's knowledge, an operation was performed, subsequent history unknown. Twenty cases of glandular tuberculosis came under treatment; eight had a course of five months or more with complete disappearance of the enlarged glands and marked improvement in general health; in the other cases treatment was carried out in a more or less desultory fashion with inconclusive results. A number of cases of so-called marasmus—some of which were probably instances of cryptogenic tuberculosis—did well under the influence of the hypophosphites. In twelve cases of pulmonary consumption with complications, the treatment had no effect whatever; they are known to have died.

When the hypophosphites are administered in sufficiently large doses for a period of at least six months in a case of tuberculosis, the effects are manifold and sure. While they exercise no primary influence on cough and the frequent chills to which the phthisical is so susceptible, there exists in the writer's mind no doubt as to their potency on the disease itself; with appropriate symptom-treatment the patient gradually loses his cough, insomnia, night-sweats, anorexia, and so forth; the physical signs of active disease disappear; there is a gain in weight, metabolism improves, and full capacity for work gradually returns. In women, the menstrual functions are also beneficially affected. These improvements are not evanescent, patients who have had a course of the hypophosphites not only remained in good health, but actually put on flesh two years after treatment was discontinued; no recrudescence or extension occurred in a number of cases examined from time to time. Some patients who had undergone treatment elsewhere without benefit, almost immediately experienced a degree of improvement on the exhibition of the hypophosphites; others never failed to resort to their sheet-anchor under the storm and stress of an exacerbation. The prognosis in tuberculosis treated by means of the hypophosphites is vastly better than when not so treated, and the younger the patient the brighter the outlook.

It would be of interest, in the light of the facts and figures

adduced, to examine the probable therapeutic action of the hypophosphites. It is stated in text-books that the hypophosphites are altered in the alimentary canal into phosphates, and thus rendered inert. This view is untenable. These salts are used empirically in medicine as tonics, generally in minute doses and combined with other tonic drugs, but such a procedure is unscientific and leads to no definite conclusion as to the real value of the hypophosphites. In order to explain the invariably good results obtained from the administration of these drugs, it is necessary to bear in mind that hypophosphorous acid ($\text{H}_3\text{PO}_2 + 70 \text{ per cent. } \text{H}_2\text{O}$) contains an atom of unsatisfied phosphorus ready to enter into combination with other elements. The acid or its salt, coming into contact with nitrogenous substances in a state of digestion, is broken up under the same influences, liberating phosphorus, which in a nascent state combines with albumen to form the proximate principle, nucleo-proteid, or nuclein, which, as has been pointed out before, is normally the most abundant proteid in the tissues of the body, and upon which resistance to microbic invasion in large measure depends; it is, moreover, recognized that phosphorus raises the temperature, and increases metabolism generally.

In conclusion, it may truly be said that the treatment of tuberculosis by means of large doses of the hypophosphites constitutes a distinct accession to modern methods. The experience gained by the writer in practice among the poorer classes, despite inherent difficulties and drawbacks, indicated that its general application under better auspices would be attended with brilliant results; cases, which in the ordinary way would be treated at a sanatorium, yielded to a four or five months' treatment, without recourse in many instances to a radical change in the patient's life, which is a feature of sanatorium régime. With such a useful weapon in medical armamentarium, it is the writer's considered opinion that the hypophosphites constitute a reliable and efficient adjunct or alternative to sanatorium and tuberculin treatment.

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THE PNEUMO-THORAX TREATMENT OF PULMONARY TUBERCULOSIS.

By CLAUDE LILLINGSTON, M.B., B.C.

"GIVE a dog a bad name," is a proverb admirably illustrated by the distrust, and even horror, with which the treatment of pulmonary tuberculosis by the induction of a pneumo-thorax was till recently regarded in England. The term pneumo-thorax, when associated with pulmonary tuberculosis, conjures up in many a practitioner's mind the picture of a consumptive gasping for breath and suffering from shock. There is, it is true, no more resemblance between an accidental pneumo-thorax, and one gradually and scientifically induced, than there is between a laparotomy effected by a bursting shell, and that carried out by a skilled surgeon; yet even consultants of repute have floundered heavily into this snare, and have banned the treatment by pneumo-thorax on account of its hypothetical resemblance to its namesake. Fortunately, the treatment is now better appreciated, and a suggestion from the Editor of *THE PRACTITIONER* that this special number should include an account of the treatment is indicative of its growing popularity among the leaders of the profession.

Early in 1909, when I was a patient at Mesnalien Sanatorium, in Norway, where I had been invalided completely for over two years with febrile pulmonary tuberculosis, my attention was drawn to Forlanini's pneumo-thorax treatment by my friend Dr. Holmboe, who had studied it under Professor Saugman in Denmark. Having nothing to lose, I gladly took the risks of the operation. The temperature fell to normal, and the cough and expectoration ceased altogether; and the following year, I returned to my work in England, where I was surprised to find the treatment was practically unknown.

In August, 1910, Dr. S. Vere Pearson, Dr. A. de W. Snowden, and I induced an artificial pneumo-thorax at Mundesley Sanatorium in a patient whose disease was mainly one-sided,

and whose chances of recovery under any other form of treatment seemed negligible. He made an excellent recovery, and, when I last heard of him, more than two years after the operation, he was keeping well. In December, 1910, Dr. Leonard Colebrook and I induced an artificial pneumothorax at St. Mary's Hospital in a patient whose left lung was involved throughout, and whose temperature and opsonic index were most unsatisfactory. After alternate compression of the two lungs, a complete recovery was made, which has since been maintained. These two cases, full accounts of which appeared in the *Lancet* for July 15th, 1911, are, I believe, the first of their kind in England. Now, there are from 50 to 100 patients who have undergone the treatment in this country. This is, however, a small number compared with the hundreds of cases on the Continent, in the leading sanatoria of which the pneumo-thorax treatment is as much a matter of course, in suitable cases, as an appendicectomy in certain cases of appendicitis.

The treatment is based on the old clinical observation that pulmonary tuberculosis is sometimes arrested by an accidental pneumothorax. Dr. L. Spengler has collected six such cases. Unfortunately, an accidental pneumo-thorax is commonly followed by fatal sepsis and shock, so that formerly there was seldom an opportunity for observing the gradual arrest of tuberculosis in a compressed lung. The causes of this arrest are: limitation of auto-inoculation by immobilization of the lung; compression and improved drainage of tuberculous foci and cavities; and fibrosis, which effectually encapsules diseased areas in the lung. Other causes, such as trophic excitation of the pneumo-gastric nerves, and the starving of the aerobic tubercle bacillus in an atmosphere of nitrogen, have been adduced to account for the beneficial action of a pneumo-thorax. Be the causes what they may, the fact remains that in suitable cases an artificial pneumo-thorax speedily banishes cough and expectoration, the patient regains weight and general vigour, and the temperature falls to normal in a few days. This fall is well shown in Pearson's temperature observations, recorded in the *British Medical Journal* for October 12, 1912.

There are two operations in vogue. The open method,

still successfully practised by Professor Brauer and some of his pupils, consists in dissecting down to the parietal pleura through an incision made over an intercostal space. A blunt cannula, connected with a manometer and a cylinder of gas, is thrust through the parietal pleura, and, if no adhesions exist at this point, several hundred cubic centimetres of gas are admitted. Nitrogen is preferred, as it is less quickly absorbed than other gases. The method by puncture, devised by Forlanini, consists in introducing nitrogen into the pleural cavity through a hollow needle—the size of a darning needle—connected with a manometer. The open method bristles with septic pitfalls; the method by puncture may, in unpractised hands, lead to fatal gaseous embolism. For several years, the advocates of one method have diligently collected the fatalities of the other, and the tale of disasters is therefore long and lurid.

The recent improvements in the technique of Forlanini's method have, however, reduced the risk of gaseous embolism to a negligible quantity, and during the discussion on artificial pneumo-thorax, at the International Congress in Rome, the greater popularity of Forlanini's was evident. Sudden death from embolism or shock may, it is true, follow this method, as it occasionally follows exploratory puncture or lavage of an empyema; but it is rare, and I have never met with it in the course of about 200 injections. The numerous precautions to be taken against fatal accident are described in full by Pearson and myself in Latham and English's *System of Treatment*, Vol. I.

The type of case most suitable for the treatment is one in which the disease is active and extensive in one lung, absent or slight in the other, which for some time to come must do the work of two. There are many other phases of pulmonary tuberculosis in which the treatment may be advisable. The disease may apparently be slight, yet it may have reduced the patient to years of invalidism, from which he would escape at all costs. On the other hand, the disease may be fairly extensive in the lung least affected, and yet the temperature falls as soon as the other lung is immobilized. Laryngeal disease frequently subsides when the pulmonary disease is arrested, and a patient, now under the care of Dr. Esther Carling, at

Maitland Sanatorium, has regained his natural voice since the induction of a pneumo-thorax a year ago. Hæmoptysis, when persistent and serious, is also an indication for the treatment, which is suitable for about ten per cent. of all patients suffering from pulmonary tuberculosis.

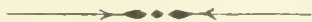
Complete adhesion of the pleural surfaces prevents the formation of a pneumo-thorax, and partial adhesion sometimes prevents satisfactory immobilization of the lung. Unfortunately, adhesions cannot be demonstrated without exploration with a needle fitted to a manometer. I have lately seen, in consultation, patients who were moribund and comatose, and whose lungs were involved from apex to base on both sides. To attempt anything more than the consolation of the relatives would, of course, in such cases be a farce. No hard-and-fast rule can be made for the selection of suitable cases, and every case must be considered on its own merits.

The treatment should be continued for a year or two. After a few weeks, the "refills" of gas are necessary only at intervals of from three to four weeks, and the patient can resume his work within a few minutes of an injection. The treatment does not, therefore, enforce idleness for a long time. When the injections cease, the healthy pulmonary tissue usually expands in a couple of months, while the scarred portions of the lung remain collapsed. If, however, the visceral pleura has lost its elasticity owing to the organization of a fibrinous deposit on its surface, both healthy and scarred lung must remain permanently collapsed. This complication is favoured by a pleural effusion which occurs in every third case, and which is almost invariably of tuberculous, not septic, origin.

Patients seldom submit to the treatment till all other methods have failed, till even *spes phthisica* has ebbed away, and the third stage of the disease has long since been reached. It is sorry material, therefore, out of which so many recoveries have been effected. As even in the third stage transient improvement is often observed, with or without any special treatment, it is essential in gauging the value of the treatment to test it by the ultimate results in a large number of cases. The material in this country does not satisfy these conditions, for scarcely a dozen cases exist in

which a pneumo-thorax has been induced more than 2 years ago. It is accordingly necessary to quote the reports of Continental workers, whose material is large, and whose results have stood the test of years of experience. Dr. L. Spengler has published an account of 15 patients, who began the treatment from 9 months to 4 years before the report was issued. The prognosis seemed hopeless in 12 cases, and in the remaining 3 it was very bad. Fever, cough and tubercle bacilli disappeared, and capacity for a full day's work was restored in every case. Professor Saugman, in a paper read before the Swedish Medical Society in February, 1911, reported 35 cases of artificial pneumo-thorax induced before the 1st of July, 1910. In several cases, the treatment had been started more than 3 years earlier. In every case, the whole of one lung was involved, and the disease in the remaining lung was seldom very slight. Of 17 patients who were febrile, 13 became afebrile, and 9 patients subject to recurrent attacks of fever became permanently afebrile. All had tubercle bacilli, which disappeared in about half the number of cases. In this connection, Saugman points out that, while combined sanatorium and tuberculin treatment banish tubercle bacilli from 25 per cent. of patients in all stages of the disease, the pneumo-thorax treatment banishes tubercle bacilli from 50 per cent. of patients in the third stage of the disease. The fate of the 35 patients was as follows: 5 had completed the treatment and had returned to their work; 13 were "symptom-free," but still continued the treatment either at home or in the sanatorium; 10 had regained a fair degree of health, but the ultimate result was yet uncertain; 7 had died, death being due to technical errors in 2 cases, and to appendicitis in one case.

It is sincerely to be hoped that the treatment of pulmonary tuberculosis by the induction of an artificial pneumo-thorax will become more generally known, and that it will soon be available for the hundreds of patients whose disease is chiefly unilateral, and who are now rotting away in infirmaries and homes for the dying.



CONTINUOUS ANTISEPTIC INHALATION IN THE
TREATMENT OF PULMONARY TUBERCULOSIS.

By C. MUTHU, M.D., M.R.C.S., L.R.C.P.

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THE recent revival of antiseptic inhalation in the treatment of pulmonary tuberculosis gives me an opportunity to describe this method of treatment as carried on at our sanatorium for the last few years. Antiseptic inhalation has a classical history. The idea that volatile substances inhaled into the lung have a beneficial effect upon the lung is as old as the ancient Greeks. Even before the time of Hippocrates it can be shown that the germ theory and the inhalation treatment were anticipated by the Indians. Susruta, the father of Hindu surgery, advised that incense made of aromatics should be kept burning while the operation was being performed, evidently to purify the air of noxious germs. We read in the classical work of Charaka, a Hindu physician who lived about 2,500 years ago, that different spices, gum resins and fragrant wood were ground into powder and made into a paste and smeared over thin tubes or sticks and lighted, and the smoke was inhaled in diseases of the throat and chest. Even to the present day the Hindus burn these fragrant sticks in their sick rooms and in their temples. Galen sent his consumptive patients to go and live near Vesuvius so that they could breathe the air charged with sulphur. Laënnec, the inventor of the stethoscope, in his great work, "*Auscultation médiate et des maladies des poumons et du Cœur*," makes mention of the inhalation of vapours from aromatic plants, balsams, myrrh, sulphur, etc., in the affections of the chest.

Coming back to our present time, many distinguished names like Dr. Ruata of Perugia, Dr. Beverley Robinson of New York, and in this country, Sir William Roberts, Dr. Coghill, Dr. Burney Yeo, and Dr. Wilson Fox stand pre-eminently among those who have used inhalation in the treatment of consumption. Lately, Dr. David Lees has come forward to champion the cause of this mode of treatment, and has published about sixty successful cases in the Bradshaw lecture, which he delivered in November this year. In 1895, I first treated a consumptive patient with the inhalation of creasote, carbolic acid, and iodine. The patient was a married man,

then working at Houndsditch, London, and presented all the classical symptoms—emaciation, fever, cough, and expectoration which contained tubercle bacilli. He made a good recovery and is now living at Sheffield with a family of five children grown around him. Ever since 1899, when I began sanatorium treatment, I had greater opportunities to use the inhalation in a more systematic way. Some of the patients of the first batch treated in 1899 are still living.

The inhaler which I employ (Fig. 1) is one which I have devised after the pattern of Dr. Yeo and Dr. Ruata. It is light,

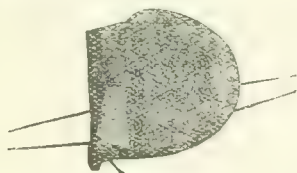


Fig. 1.

made of perforated zinc, to admit both air and antiseptic vapour freely, and covers the nose and the mouth. We use mainly four kinds of solutions to allow a choice in the variety of antiseptics and a gradual increase in their strength. A contains formaldehyde ($2\frac{1}{2}$ per cent.), with menthol, pumiline pine, chloroform and rectified spirit. B has 5 per cent. formaldehyde, with guaiacol ($12\frac{1}{2}$ per cent.) menthol, pumiline pine, chloroform and rectified spirit. Formalin used in these mixtures is not irritating, but pleasant and agreeable. C contains guaiacol (25 per cent.), terebene ($12\frac{1}{2}$ per cent.), with menthol, pine, chloroform and spirit; while D is made up with guaiacol (25 per cent.), iodine ($12\frac{1}{2}$ per cent.), terebene ($12\frac{1}{2}$ per cent.), pumiline pine, chloroform and rectified spirit.

As formalin contains more than 50 per cent. of water, formaldehyde in the form of gas is conveyed into the inhalant to make it more volatile. The advantage of using three or four mixtures is this: the monotony of using the same solution for days, weeks, and months has a wearying effect upon the mind, whereas the change and variety of solutions creates a fresh interest in the treatment and stimulates the patient to continue the inhalation and persevere till success is achieved.

MODE OF PROCEDURE.

The mode of procedure is as follows:—When a patient first comes to the sanatorium he is sent to bed, and kept there if

he shows any signs of temperature. He uses the inhaler for 2 hours the first day, 4 hours the second, 6 hours the third, and 8 hours the fourth and following days. In this way he is gradually prepared to use the inhaler a great part of the day as well as the night.

He begins with A solution during the first week, in the second week goes on to B in the day and C or D at night, and after awhile B, C or D are used alternately either day or night.

Patients keep on the inhaler while they are walking, resting, reading, etc.; in fact, they are encouraged to put on the inhaler at every available opportunity from the time they wake up in the morning till late at night, and even during the night. And as they improve and show signs of arrest of the disease, the hours are gradually reduced to 6, 4, or 2 hours a day.

It is rather difficult to dogmatize in what way antiseptic inhalation benefits the patient. I cannot help believing that volatile vapours, continuously used, enter the alveoli and have a direct action on the pathogenic organisms, inhibiting their growth and activity, and cutting short the morbid process in the lungs. This is clinically proved by the reduction of temperature, cough, and sputum, gradual disappearance of tubercle bacilli, and final arrest of the disease. Some patients improved so rapidly by its continuous use that it was impossible to attribute their improvement to anything else. It cannot be emphasized too often that the secret of success of antiseptic inhalation depends upon its being used continuously and perseveringly. The more strenuously it is employed, the better the prospect of its success. Although I have used the inhalation in many hundreds of cases, I have seen no ill-effects from its use. In cases complicated with laryngeal tuberculosis or if formalin causes any irritation of the throat and nose (which it does not in the majority of cases, as it actually hardens the mucous membrane of the air passages), the mixtures containing no formalin are substituted from the commencement.

In a few cases there was a tendency to hyperæmia, as shown in the stained sputum, owing to the negative pressure caused by the inhaler. This is rather an advantage than otherwise, as the resistance due to the inhaler favours the

flow of blood into the lungs like Kuhn's suction mask, and facilitates healing. Other uses of the inhaler are: it affords protection from dust and strong winds, and prevents any attack of influenza, cold, or catarrh of the nose from spreading downwards and starting fresh mischief in the lung, or laying open an old lesion.

RESULTS.

As to results, the beneficial effects of inhalation have been noticeable in so many cases that it is a sheet anchor in our treatment, and has become a part of the daily programme of the patient's life. I could give many instances of remarkable cases of arrest of the disease in a few months, but it might be objected that a few cases of recovery did not prove the value or the efficacy of the treatment. So giving the result in general terms in my book on tuberculosis, I have shown that out of cases treated from 1900 to 1910, about 50 per cent. got quite well—that is, well enough to resume their old or take up some new occupation. In 1911, leaving out those who only stayed a few weeks in the sanatorium, forty-two patients went through the treatment from three to ten months. Placing them under six divisions:—

Twenty made an excellent recovery; they had no physical signs and no bacilli in the sputum.

Six greatly improved; they had no temperature, very few physical signs; had they remained a little longer they would have made a complete recovery and been placed in the first division.

Five moderately improved; they had no temperature, areas of disease smaller, expectoration less, physical signs improved.

Six improved, temperature was reduced, gained some weight, physical signs somewhat improved.

Four went back.

One died of hæmoptysis.

CONCLUSION.

To sum up:—The continuous inhalation is so simple, so easy to be applied, always ready to hand, involves no risk, is inexpensive, can be used at home if a sanatorium is not available, and is efficacious in a great many cases if begun early and used with perseverance.

THE OPSONIC METHOD IN RELATION TO
TUBERCULOSIS.

By LEONARD COLEBROOK, M.B., B.S.

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WHEN we pass in review the methods currently employed for the investigation of bacterial disease, it is worthy of remark that so small a proportion of them are capable of contributing *direct* and, therefore, conclusive evidence as to the precise nature of that disease. Of such methods may be mentioned the quest of tubercle bacilli in sputum, of spirochaeta pallida in condylomata and chancres, of protozoa or microbes in the blood stream.

Into another and much larger category may be grouped all those methods to which we habitually turn for their quota of *circumstantial* evidence. Among their number is to be found the opsonic method, with which we are here chiefly concerned, and along with it all the methods of routine physical examination (including X-ray and electrical examination), chemical and cytological tests of urine, cerebro-spinal fluid, etc.; biological tests, as leucocyte counting, the agglutination and Wassermann reactions; the histological examination of tissues, etc.

It will at once appear that these latter methods have but little in common, and could scarcely be assessed with advantage as having this or that degree of utility, since with each of them such a measure will present a large range of variation, corresponding with that of the circumstances in which the method is employed. When we turn from the methods themselves to consider the evidence furnished by each, we are again met by a like inconstancy of its values, but nevertheless are able—indeed, we are obliged, for reasons of expediency—to construct a quantitative scale upon which these varying values may severally take rank, according as they carry a *greater or less degree of probability* in favour of any precise diagnosis.

It is upon such a scale, of greater or less probability, for

example, that the radiographer can, and must, assess his evidence as to the presence of tubercular disease, when this is situated in the bones of the wrist and the sacro-iliac joint, respectively; when two patients, suspected of having sacro-iliac disease, are under investigation, the one of very slight, and the other of heavy build, and again, when the tubes employed for such investigations are of different quality. Here we have called to mind but three of the many possible factors, which will influence the degree of probability attaching to the several verdicts of one method, and the reader may conveniently be reminded of a fourth, common to all these methods, viz., the skill of the observer, in its manifold bearing upon technical efficiency and the evaluation of results.

A brief scrutiny of the methods of serum diagnosis, included in the same category with X-ray examination, will avail for further elucidation of this principle, and, inasmuch as these methods are more nearly akin to the opsonic method, will the better serve for the presentation of that method in correct perspective, which is the writer's immediate purpose. The Widal reaction for the diagnosis of typhoid fever may first occupy our attention.

Upon its first introduction, Widal supposed that the blood of every typhoid patient, *and of only these*, would effect the characteristic agglutination of bacilli; that a definite affirmation or negation could, therefore, be made in respect of every individual investigated. It soon transpired, however, upon further experience, that early cases, and others of great severity, could not be relied upon to give a positive result; such a result depended, in fact, not only upon the patient being infected with the specific microbe, but also upon his having *reacted* to that infection. To this first complicating circumstance, others were added from time to time, as attention came to be directed to the microbic culture used for the test.

Widal, assuming that the microbe was a mere passive agent in the reaction, had chosen his culture without special reference to its previous history. Delépine, however, showed that the bacillus, acclimatized through many generations to growth upon artificial media, became insusceptible to the action of typhoid patients' serum. Again, it was shown that cultures

killed at 60° C. could be used as well as living cultures, and the further remarkable fact that, although boiling deprived them of such utility, heating to a still higher point restored the agglutinability of the microbes (Dreyer).

From these varied findings emerges the conclusion that a positive result depends upon at least two variable factors: the reaction of the patient to his infection, and the sensitiveness of the antigen (the bacilli) used for the test. With this conclusion in view, it becomes manifest that the character of certainty, with which the findings of the test were originally invested, can no longer be acclaimed, but that to those findings attaches an ever greater degree of probability and refinement, with every accession of knowledge upon the sensitiveness of antigens; a judgement, which will appear pertinent also to the opsonic method and other serum reactions under consideration.

An historical survey of the serum diagnosis of Malta fever reveals a somewhat similar sequence of events, but with one distinctive feature which is worthy of note. Upon its first introduction by Wright, there supervened a period of conflicting opinions, owing to the fact that various observers had obtained agglutination of the cocci *with the serum of normal individuals*, as well as with that of Malta fever patients. This particular anomaly had not arisen in respect of the Widal reaction, but, nevertheless, its occurrence was found to be conditional upon variations in the preparation of the antigen, analogous to those enumerated in connection with this latter test; and it sufficed, from the recognition of the factors essential to a properly differentiating antigen, for the test to take rank anew among those capable of affording evidence, endowed with a high degree of probability.

Yet one more agglutination reaction remains for mention, that first suggested by Arloing and improved by Koch, for the diagnosis (and treatment) of tubercular patients. The significance of this reaction was, from the first, greatly mitigated by the fact that the antigen, derived from Koch's powdered tubercle culture, was very prone to undergo *spontaneous* agglutination, and by the further fact that the occurrence of genuine, specific agglutination was conditional (as in the

case of the typhoid reaction), and followed somewhat tardily, upon the response of the patient to his infection. Thus there arose opportunities for the erroneous interpretation of both positive and negative results, and since at its best, the agglutinating power of the serum was seldom developed to a high degree, the reaction was early abandoned in favour of the opsonic method.

While the Wassermann reaction for the diagnosis of syphilis is probably also dependent upon the response of the patient to his infection, this becomes in reality a factor of small moment, inasmuch as such a response may be expected with almost complete confidence, and is wont to occur within the first week or two of the disease. The success of the method, however, is very closely conditional upon the constitution of the antigen employed, for although this has been subject to much modification in respect of its origin—syphilitic liver, human heart, rabbit's heart, lecithin, cholesterin, etc., each being advocated in turn—every one of the several modifications has required a nice adjustment of its component parts and preliminary treatment, to render it a sufficiently delicate instrument for the differentiation of sera. Another variable factor, foreign to the methods hitherto considered, had also to be reckoned with, and its inconstant elements eliminated as far as possible—this was the hæmolytic system employed as indicator.

On a *priori* grounds. it will appear unlikely that so complex a method, and one permitting of so much modification of its chief reagent, could differentiate *with certainty* between syphilitic and non-syphilitic sera. Accordingly, it occasions no surprise to find in the earlier literature of the method that a negative result was never quite above question, since a certain small proportion of known syphilitics failed to give the reaction; while a like remote possibility of error also attended a positive finding, since various observers had noted its occasional occurrence with the blood of normal individuals, and in diseases other than syphilis, *e.g.*, scarlet fever, diabetes, leprosy, and yaws; in addition, there have occurred, with every modification proposed, a certain proportion of doubtful results, inclining with but little weight to either a positive or a negative verdict.

Despite these elements of uncertainty so closely interwoven with its results, the method has never ceased to hold the attention of a great company of workers, and, from their toil through several years has come to be so far perfected that frankly positive and negative results may now be vested with a degree of probability not far removed from certainty, while really doubtful results are constantly diminishing in number.

It now remains for us to enquire at what points, and in what manner, the several features common to these four methods, bear upon our examination of the opsonic method. We may select first that feature which we have most laboured in the foregoing summaries,—the *scrupulous employment of a satisfactory antigen*.

In the earliest publications dealing with the opsonic method, the antigen (emulsion of tubercle bacilli) received but scant attention, except in respect of certain physical properties,—for example, its bacillary content and its freedom from “clumps,”—which have but little bearing upon the subject of our present enquiry.

As in the case of the other methods quoted, the promise of a sharp differentiation between the sera of normal and of tuberculous individuals was at first foreshadowed, and, in like manner, only imperfectly fulfilled. Periods occurred when tubercular sera were wont to fall too often within the normal zone, and seldom to range far beyond its confines; on the other hand, there have been times (of very infrequent occurrence be it said) when ostensibly “normal” individuals showed a wide divergence *inter se*, masking that differentiation from tuberculous patients which it is the aim of the method to detect. Nor, until very recent times, have the peculiar conditions which govern this differentiation by the opsonic method been realized.

From the published researches of Dr. Parry Morgan and Capt. Hayden,¹ and others yet unpublished by Capt. Hayden alone, it has become manifest that to the antigen again we must look for the essential factor in this opsonic differentiation. They have demonstrated that its sensitiveness may be varied at will, from a low degree, of little practical worth

¹ *Proceedings of the Royal Society, B*, Vol. 84, 1911.

by reason of the narrow zone within which tuberculous sera, tested by it, will be found to vary, up to a high degree. equally unsatisfactory in practice, as convicting many "normals" of a tuberculous taint, precisely as the too-sensitive tests of Calmette and Von Pirquet have been found to do.

The importance of the new conception to which these researches have brought us can scarcely be overestimated; it will be seen at once to give us understanding of the widely divergent values accorded to several samples of the same blood by different laboratories, and to disarm the criticism of Hort and others founded upon that classical experiment; and further, it allows us, in forming a judgment upon the value of the method, to remember that such achievements as it may already lay claim to, belong to a period in which antigens of but small capacity for differentiation have often been employed. From this circumstance, our expectation is engendered that when, in the future, the test shall always be conducted with an antigen of nicely adjusted capacity for the differentiation of sera, its verdicts will acquire a much greater degree of probability, and hence a greater value, for both diagnosis and treatment, than heretofore.

Glancing back once more to the agglutination and Wassermann reactions, we may discern another thread running between them and the opsonic method, which will repay a moment's scrutiny. This thread is the physiological provision against bacterial disease, to which these methods themselves bear witness. Normal individuals are endowed with a small, yet distinct, power of agglutinating the microbes of typhoid and Malta fevers, and of tuberculosis, and the degree of this normal reaction may, as we have seen, be varied within considerable limits, *pari passu* with variations of the antigen employed. In like manner, the complement of a normal serum may be deviated, and the presence of a certain quantum of syphilitic antibody thus (inferentially) demonstrated, by appropriate handling of the antigen employed for the Wassermann reaction. Further, it is common knowledge that normal serum is endowed with opsonic power.

With these correlated observations in our view, it becomes the more easy to appreciate that all the divergences from the normal in sera, by which we seek to arraign a particular

microbe in respect of any malady, are divergences of degree, and not of kind; and hence, that the evidences furnished by these serum methods are, strictly speaking, expressible, with propriety, only in quantitative terms. Although the agglutination of typhoid bacilli with a 200-fold dilution of serum creates so great a probability in favour of typhoid fever as to be tantamount to certainty, it is quite otherwise if the serum will admit of no more than a 16-fold dilution, as compared with a normal-control serum agglutinating up to a 4-fold dilution; and it is important, that such a result should be interpreted by the laboratory worker to the clinician with only such weight of probability as he shall deem to be appropriate, having regard to the precise conditions under which the test was performed.

And so it is with the opsonic method. The range of the indices of non-tuberculous sera has for some years been bounded arbitrarily by the figures .80 and 1.20, and although such an arrangement has proved in the main satisfactory,¹ it does not justify the opsonic worker in attaching the same diagnostic value to a random index of 1.21 as to one of 1.75; or the clinician, who has sometimes demanded that the method *must* admit of such inflexible treatment of its figures; that, in fact, it must make answer "Yes" or "No," if it is to aid him in his practice. It may not be out of order to remind those who proffer such a demand, that the methods here in question are of the same class as most of those to which they habitually have recourse for the solution of every clinical problem—methods affording only circumstantial evidence in favour of any precise departure from the normal state.

The essence of his training in physical examination of the chest lies, for the student, in his gradual recognition of a normal standard *and its range of variation*; and his value, as an observer later, in the ability he acquires readily to detect, and appraise the probable significance of, any divergence from that standard. Or, to cull another example from the province of radiography, the value of X-ray examination of the chest

¹ The experience of these years has taught us that caution is necessary in the interpretation of *low* indices for diagnosis, since they have not infrequently been met with in cases of chronic staphylococcal infection (*vide* Case II. below), syphilis, and diabetes, when there was no other reason to assume an added tuberculous infection, as well as in infants of from three to twelve months.

for the diagnosis of phthisis is seen to resolve itself usually into the ability of an expert to differentiate *between a normal and an abnormal* degree of "brightening," "mottling," etc.

It cannot be gainsaid that to the detection of advanced phthisis each of these methods brings evidence amounting to little less than certainty, but for the difficult, and vastly more important, detection of the disease in its earliest stages, neither of them can speak except in temperate terms of probability varying widely with the skill of the observer, the quality of the X-ray tube, the build of the patient, etc. Despite this latter circumstance, and the claim here advanced, that to this particular problem the opsonic method can bring evidence having a higher coefficient of probability than either of these physical methods, we can ill afford to forego the use of them; or indeed of any other innocuous procedure capable of contributing a definite, if small, quatum towards an accurate diagnosis. In this connection, the dictum of Metchnikoff may be called to mind, which applauds the clinician as the really clever man in comparison with his colleague the pathologist, who seeks only the surer evidences of disease among the living, and its more obtrusive signs among the dead.

From these general considerations of the normal standard, and of the manner of its differentiation from pathological states, we now come to enquire in particular by what artifices can the opsonic method subserve the routine practice of medicine.

Firstly, for diagnosis. When treating of the agglutination and Wassermann methods, some attention was directed to their dependence upon the natural response of the patient to his infection, whence there was seen to arise the possibility of an erroneous interpretation of negative results. Very frequently, advantage may be taken of this same response for the diagnosis of a tuberculous infection by the opsonic evaluation of a random sample (or samples) of the patient's blood.

An example of such usage may briefly be narrated:—

CASE I.—A girl, A. M., aged 20, came to St. Mary's Hospital on account of a large glandular swelling on the left side of the neck, *exquisitely tender to the lightest touch* and accompanied by some fever (101° F.). The history

afforded no evidence of previous tuberculosis, and was quite definite as to the acute onset of the present malady within the past ten days. The opsonic index was found to be 1·18, and on two subsequent days within the first week 1·38 and 1·14 respectively. These figures,¹ although but little beyond the range for normal individuals, were regarded as definite evidence of response to a tuberculous infection, and when, shortly after, surgical treatment was adopted, the thin pus evacuated from the glands was found to contain many tubercle bacilli, and no other microbes.

But if, on the other hand, such evidence of a natural response is not forthcoming—the opsonic values obtained lying within the normal range—and important issues are at stake, a negative verdict will, in prudence, be withheld pending the result of further enquiries, to which the opsonic method lends itself. Of these further enquiries the one with which we are at this point concerned is the purposive excitation of the patient to an immediate response by means of an *auto-inoculation*.

Illustrations from practice may, with advantage, again be introduced.

CASE II.—M. W., a woman, aged 52, was sent to the Inoculation Department, St. Mary's Hospital, with a swollen, hot, and painful wrist, which had originated somewhat gradually a few weeks earlier. A diagnosis of tuberculous infection was suggested by the local condition, but could not be adopted with complete assurance in view of the patient's age, previous good health, and a history of coincident pain in the shoulder. The tuberculo-opsonic index was found to be 1·01, a figure which afforded no evidence of response to a tuberculous injection—nor by itself could suffice to negative it. Under these circumstances recourse was had to the method of auto-inoculation.

A Bier's bandage was lightly applied for half-an-hour to the forearm, in order to promote passive congestion throughout the wrist. By this means, it may be conjectured, some of the products of microbic activity were directed out of the infected area into the neighbouring healthy tissues, and the formation of specific bacteriotropic substances there engendered. On the removal of the bandage from the forearm, the normal circulation would be restored, and such bacteriotropic substances, as were in course of time produced, would find their way into the general blood stream.

For the detection of these substances, which indicate the response of the patient, samples of blood were drawn from her finger, respectively, *before* the Bier's bandage was applied, and at intervals *after* its removal,

¹ This narrative refers to 1910. Recent developments, referred to above in connection with antigens, allow us to hazard with some assurance the opinion that values of not less than 1·5 would have been recorded with the same "bloods" had the case occurred during 1912.

and submitted to the opsonic test.

The values obtained are here set forth:—

				<i>Tuberculo- opsonic Index.</i>
Before Bier's bandage was applied—	-	-	-	.46
$\frac{1}{2}$ hour after removal of Bier's bandage	-	-	-	1.33
4 hours " " "	-	-	-	.98
24 hours " " "	-	-	-	1.37

This considerable variation in opsonic power was held to establish the diagnosis of tuberculous arthritis—a finding to which the patient's subsequent progress has yielded substantial confirmation.

As being complementary to the above case, and also affording illustration of a further usage of this procedure by auto-inoculation—viz., for differential diagnosis—we may refer to the following:—

CASE III.—A man, J. M., aged 44, was admitted to St. Mary's Hospital under Mr. Warren Low with a subacute inflammatory swelling about the knee, accompanied by some fever (99° to 101° F.), and much pain. This condition had commenced some weeks before without antecedent injury, and on enquiry a history of several boils could be elicited, but the last of these had preceded the onset of this latter infection by nearly two months. The diagnosis from clinical data was far from clear, but Mr. Low's opinion so far inclined towards tubercle, as to make him very doubtful as to the advantage likely to accrue from operative procedures.

Under these circumstances the Inoculation Department was asked to investigate the patient by the opsonic method, and, if it was deemed appropriate, to apply vaccine treatment.

From the examination of random samples of the man's blood an unequivocal statement in respect of tubercle was not forthcoming,—indices of .94, .76, and .90, being recorded in turn—the exact diagnosis was therefore sought by an auto-inoculation test. To this end a Bier's bandage was applied to the thigh, and hot fomentations over the affected knee.

The effect of this procedure upon the tuberculo-opsonic index was as follows:—

				<i>Tuberculo- opsonic Index.</i>
Before the application of Bier's bandage—	-	-	-	.90
$\frac{1}{2}$ hour after Bier's bandage was removed	-	-	-	1.08
4 hours " " "	-	-	-	1.04
24 hours " " "	-	-	-	1.13

For further assurance, and with a view to discrimination between a tuberculous infection and a possible staphylococcal osteomyelitis the test

was repeated, and the following results obtained.

	<i>Tuberculo- opsonic Index.</i>	<i>Staphylo- opsonic Index.</i>
Before Bier's bandage was applied—	- '88	1 '32
½ hour after Bier's bandage was applied	- '76	1 '16
4 hours " "	- '94	1 '14
24 hours " " "	- '94	1 '52

A definite opinion was now given that the condition was not of tuberculous origin, but that its causation by staphylococcus was attested with considerable probability by these experiments. When resort was had, a little later, to surgical operation, a condition of osteomyelitis of the lower end of the femur was discovered, and staphylococcus obtained by culture.

The reader who is interested to follow further the manifold problems, to which this procedure has proved itself applicable for treatment as well as diagnosis, may be referred to its original publication in the *Lancet* of November 2nd, 1907.

Two other artifices, subsidiary to the opsonic evaluation of a random sample of a patient's blood, remain for brief mention. It was shown by Wright, in 1906, that, by the simple expedient of heating their sera to 60° C. before subjection to the opsonic test, we are frequently enabled to differentiate between tuberculous patients and normal individuals; in the case of the former, the serum usually retains a considerable part of its opsonic activity, which is almost entirely dispelled from the serum of normal individuals.

This differentiation, be it said, is not less conditional upon the employment of a satisfactory antigen, that is, one adequately furnished with bacillary detritus, than is the case under the ordinary circumstances of opsonic work.

The other artifice, which will sometimes be found of service for diagnosis, was described by Wright in the same paper with the above test. It is applicable chiefly to pathological conditions associated with the formation of a serous exudate, and consists simply in a comparison of the opsonic value of the exuded fluid with that of the circulating blood drawn from the patient at the same time. When such an exudate is a manifestation of tuberculous disease, its opsonic value will usually be found far below that of the circulating blood, when tested in respect of the tubercle bacillus; whereas, no such differentiation will be forthcoming in respect of

other microbes.

Having thus briefly suggested the *modus operandi* of the opsonic method in some of its aspects, it may help now to clear the field of view and bring all that has gone before nearer to the actual conditions of practice, if we put to ourselves the question—Under what circumstances is it worth while having recourse to the opsonic method for the diagnosis of tuberculous infections?

The summary, in which these circumstances will be set forth, is framed upon the principle that an exact diagnosis is in all cases desirable, and that the influence of economic considerations of time, toil, and finance, upon the attainment of this ideal may with advantage be left to find its appropriate level in each reader's judgement.

Without further preface, it is submitted that the opsonic method finds appropriate application for diagnosis:—

1. In connection with "closed" infections—that is, infections which furnish no exudate for bacteriological examination, and thereby preclude the possibility of a *direct* diagnosis—when from consideration of the history, and of the evidence afforded by clinical methods and X-ray examination, there has not resulted an aggregate of probability amounting to practical certainty in favour of a specific diagnosis.

The conditions thus outlined will bring into this category many cases of adenitis, of joint and bone lesions, and notably also the large body of young patients, who manifest the earliest signs of phthisis by wasting, slight cough without sputum, vague ill-health, or a so-called "influenzal attack."

2. In connection with "open" infections, when direct search of sputum, urine, pus, &c., has failed to reveal the tubercle bacillus, and, in addition, there obtains the element of uncertainty characteristic of the former class.

When the attempt is made to pursue a similar enquiry into the sphere of therapeutics, it is at once opposed by the difficulty of framing a concise statement, applicable to a situation of such complexity as that which is, at present, manifested

by tuberculin therapy. While the agglutination and Wassermann methods have only exerted a small and circumscribed influence upon treatment, the opsonic method has shown itself to be susceptible of very various usages and, indeed, of chief importance, in this sphere. Apropos of this "opsonic control" of treatment, Rivi re and Morland, in their recent book on "Tuberculin Treatment," state, "Both of us have used it as a guide to specific treatment, and have learned much from it of dosage and interval, but having applied the knowledge so gained, regard it no longer as an indispensable guide, but in the light of a help in doubtful cases and the clue to difficulties."

If, as we suppose, the latter part of the quotation is intended to mean that the *opsonic control is no longer required in every case*, we may substantially subscribe to the summary of these authors, albeit its several component parts seem, in our judgment, to merit either emphasis or qualification. Thus, the value of the opsonic control, which these authors acknowledge as a guide to dosage and interval, can scarcely be exaggerated. The revival of tuberculin therapy in England was directly connected with the earliest elaboration of this control, and upon the guidance which it has constantly afforded has been built up the system associated with the name of Wright, and characterized by the employment of minimal doses.

The quotation given above should, we assume, be read as having application more particularly to the treatment of phthisis, than to that of surgical tuberculosis. If this were not the case we could the more readily endorse the view set forth in its latter half, for in connection with surgical tuberculosis, the current practice of the Inoculation Department at St. Mary's Hospital is framed upon a very similar view.

Out-patients attending for tuberculous glands, joints, skin lesions, etc., are frequently treated from the first without opsonic control, or with but two or three estimations; but if their progress is not entirely satisfactory, or if, by default of guidance, we effect untoward results by an overdose, this control is at once instituted, and, if necessary, they are admitted to the wards of the Department for closer observation. Such

a system is adopted of necessity in a large hospital out-patient practice rather by way of compromise, and despite the fact that a large experience of such practice in the past, with its correlated observation of opsonic and clinical phenomena, does not allow us to rely so confidently upon generalizations in regard to dosage as we could wish. Susceptibility of individual patients to the action of tuberculin would seem to be a very variable factor, and, pending the elaboration of further methods of investigation, offers an obstacle to the wide employment of such generalizations.

In connection with phthisis, the special tendency to excessive auto-inoculation also comes into prominence, and hence it is that, for us, almost every case of the disease constitutes a *difficult case* for whose treatment we can ill afford to dispense with a single procedure which can bring us aid.

The opsonic control is first applied, in the case of phthisis, to determine whether or no such auto-inoculations from the seat of disease are habitually occurring, and whether, in consequence, the patient is requiring rest in bed, or may wisely be treated as an out-patient. It is further employed throughout the course of treatment to ascertain the optimum dose of tuberculin, and at intervals to regulate this afresh; and finally, as in the case of surgical tuberculosis, to determine at what point specific treatment may safely be abandoned. To this latter end, we may apply the procedure of purposive auto-inoculation by exercise, as described above in connection with diagnosis, or may simply watch, with the passage of time, the opsonic level which the patient maintains.

In conclusion, it may be pointed out that no other method, having as its objective the investigation of the patient's immunity to tuberculosis, has yet shown itself capable of making valuable contributions to practice, and that such claims, as we have already advanced in connection with the opsonic method, may well endow it with a degree of utility proportional to the importance of the disease in question.

To Sir Almroth Wright, I am indebted for many helpful suggestions in the preparation of this paper.



TUBERCULIN AND TUBERCULOSIS.

WITH SPECIAL REFERENCE TO DISPENSARY TREATMENT.

By W. CAMAC WILKINSON, M.D., F.R.C.P.

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THERE are many kinds of tuberculin. The original kind was called Old Tuberculin. These preparations enabled Koch to introduce an entirely new method of diagnosis for tuberculosis, for which discovery alone his name should be remembered throughout the ages, although the value of the test is not either widely understood or generally acknowledged. Indeed, we are told by observers, whose accuracy falls far short of Professor Koch's, that the tuberculin reaction may develop in measles, typhoid fever, diphtheria, etc. A prolonged and serious study of tuberculin, as a diagnostic agent in accordance with Koch's directions, leaves no doubt in my mind that, until tuberculosis is studied through tuberculin, used as a routine agent in diagnosis, when the specific or ætiological diagnosis defies other methods of investigation, finality in diagnosis is out of the question. Without finality, we cannot hope to reach that vantage ground which opens out the splendid prospect of dealing with tuberculosis in the very earliest stages (*in den allerersten Stadien*).

This hesitancy to accept the dictum of Koch upon the value of tuberculin in diagnosis may be traced, not so much to the uncertainty of the method, as to the idea still obsessing the minds of many medical men, that tuberculin used for such a purpose may kindle into activity a focus of disease that would, otherwise, remain latent and harmless. Those who have used tuberculin freely and frequently for diagnostic purposes, have not seen any trustworthy evidence to justify this sceptical argument. Any latent tuberculous focus may become active without the extraneous help of tuberculin, and it is doubtful whether a diagnostic dose of tuberculin can favour such contingency. It is far more reasonable to suppose that tuberculin properly used would rather smother than quicken the smouldering embers, because

the extraordinary effect of tuberculin in bringing about a process of healing, that otherwise defies natural processes, justifies the view that such doses of tuberculin would tend to check rather than encourage the tuberculous process.

It is ancient history that the investigations of Virchow started the denunciations of tuberculin as a diagnostic agent, and too few are familiar with the subsequent interpretations of Virchow's investigations, which amounted to a virtual recantation. Virchow drew his conclusions from post-mortem examinations of tuberculous lesions, which had been irritated further by secondary, or mixed infections. It is well known that measles, influenza, whooping-cough, streptococcal and pneumococcal infections may intensify the activity of the tubercle bacillus, without the extraneous thrust of tuberculin artificially introduced into the circulation. I have seen little evidence to justify the view that tuberculin thus used can render a latent tuberculous lesion active. It may certainly cause a temporary inflammatory process, but this tends rather to deaden than to quicken the simple process of tuberculosis. This view is strengthened by the very numerous and almost uniform observations that tuberculin properly used is the most potent agent in arresting the tendency to hæmorrhage, and, in my experience, tends also to check metastasis, which is too often characterized by the tragic onset of tuberculous meningitis.

Tuberculous meningitis is no uncommon catastrophe in any form of tuberculosis, even in pulmonary tuberculosis. In all my experience with tuberculin, dating back to the year 1890, I have seen two cases of tuberculous meningitis following within a very short time of the first injection of tuberculin. In both these cases, the supervention of meningitis occurred within such a short space of time after the dose was given, that it is hardly conceivable that the generalization could have been the effect of the dose. One can imitate the phenomenon of generalization in animals by the simple expedient of injecting tubercle bacilli into the circulation. In such circumstances, the development of the tuberculous process in the meninges requires at least some weeks, and in both my cases the meningeal symptoms showed themselves within a fortnight.

According to my view, the tuberculin was given when the tubercle bacilli had already invaded the meninges, and the inevitable series of events took place without having any relation at all to the injection of tuberculin, except as an antecedent incident. There is no other way of explaining the extreme rarity of this tragic catastrophe of tuberculous meningitis after injections of tuberculin. In both the instances, in which this tragic event followed the injection of tuberculin, a subsequent investigation of the condition of the patient, immediately preceding the use of tuberculin, supported the view which I hold, that already generalization had occurred and meningitis was inevitable, if it did not exist.

There are those who hold that generalization of tubercle bacilli in the circulation is a common event in almost any stage of tuberculosis (Rosenberger, Rabinowitch), so that, apart from injections of tuberculin, the presence of tubercle bacilli in the circulation is not very rare. I may mention here a very remarkable series of events that followed an intravenous injection of tuberculin, which I gave in an advanced case of pulmonary tuberculosis, that had been complicated with ulceration of the larynx, and a secondary tuberculous formation of the size of a walnut in a costochondral articulation. Soon after the injection, the patient's temperature rose to 105° , and remained at $104-105^{\circ}$ for four or five days. At the same time, the patient became wildly delirious and maniacal. These desperate symptoms gradually subsided, and the patient completely recovered from the cerebral attack.

In another instance during the administration of tuberculin, the temperature rose, not immediately, but within 48 hours of the dose, to 102° and persisted for two or three days. In this instance also, the patient became delirious and violent; nevertheless, he made an absolute recovery, and remained perfectly well for many years. In both these instances the disease was in an advanced stage, and I argued that tubercle bacilli had of their own free will escaped into the circulation and, perhaps, lodged in the vascular apparatus of the brain. The tuberculin then causing the disintegration of these bacilli *in situ*, had liberated toxins, mainly endotoxins, which

produced these extraordinary brain symptoms.

At any rate, in both these cases the body was so far immunized that, beyond the transient, if severe, disturbance, the patients recovered completely. I admit these are nasty and disconcerting experiences, but they show at least that there could not have been any definite tuberculous meningitis. One may also argue that if tuberculin can cause this ready mobilization of bacilli in a quiescent focus, it is impossible to explain the absolute immunity from these tragic incidents in hundreds of cases of pulmonary tuberculosis in all stages, even in the third stage when very large doses of tuberculin have been administered, often with violent reactions, even with impunity.

TRAGIC OCCURRENCES WHEN TUBERCULIN HAS NOT BEEN GIVEN.

Clinical experience shows that there are many risks inherent in various tuberculous diseases, which do not need injections of tuberculin for their development, and if an injection is given immediately before these grave and fatal incidents occur, it is very easy to attribute the occurrence to the casual incident of an injection which has preceded it. I can give three striking instances in which this sort of reasoning would have been easy, if mere chance had not determined that the dose was not given.

I had decided to give a test dose of tuberculin in a case of abdominal disease, which was probably tuberculous. The test was not given, but the patient died the same night. Dr. Griffiths and Dr. Hilda Clark were each saved from a similar accident by mere chance. In all these cases, death occurred quite unexpectedly, and if the dose had been given the deaths would have been attributed by many to the antecedent incident. No doubt, in many cases, fatalities that have occurred within a short time of an injection of tuberculin, have been placed to the credit of tuberculin, although the tuberculin had nothing whatever to do with it. This confusion of the *post hoc* and *propter hoc* can only be eliminated by a large number of observations made under similar conditions. Such observations have been recorded by Professor Koch and many others, including myself, which leave no room for doubt that this danger, assumed to be possible when tuberculin injections

are given for diagnostic purposes in proper cases, does not exist.

One is only justified in speaking from one's own experience, and I cannot remember any record which showed that a tuberculin injection rendered a quiescent focus of disease active. Evidence, so far as it goes, shows rather that tuberculin properly used in these cases, renders such foci inactive for all time. Were it not so, it would hardly be possible to give a high value to tuberculin as a curative agent.

TUBERCULIN IN TREATMENT.

We may now proceed to discuss tuberculin from this point of view, and one cannot repeat too often that the earlier the diagnosis of tuberculosis is established, the more certain we are of success in curing the disease. The value of early diagnosis is well exemplified in the specific treatment of diphtheria and tetanus, and even in the treatment of cancer. Accordingly, we should be foolish to disregard any instrument or agent which renders early diagnosis possible. Too often, indeed, the diagnosis of tuberculosis, especially of pulmonary tuberculosis, is anything but early, and it may be very late for different reasons. Those who withhold tuberculin in early or doubtful cases may be inflicting an injury upon their patients, which can never be undone. I have lately seen two instances, in which the golden opportunity of early diagnosis was lost, because tuberculin was not used. In both these instances, tuberculosis had been excluded, and, within a short space of time, tubercle bacilli were found in the sputum. The medical men in these instances disapproved of the use of tuberculin for diagnostic purposes.

The specific treatment of tuberculosis must be carried out upon a definite plan so as to bring about active immunization. Experiments upon animals show, how much more difficult it is to create immunity in an animal already infected with the disease than to immunize a normal animal against disease. In the treatment of tuberculosis with tuberculin, we are attempting the more difficult task, although one condition favouring success in tuberculosis is the protracted course of the disease. Clinical evidence seems to show that immunity is not secured except by means of relatively large doses.

It has been my experience that unless from half to one cubic centimetre of the stronger preparations of tuberculin can be given, the chances of successful treatment are not great.

In my last interview with Professor Koch, not very long before his death, when we were discussing this very point, he stated emphatically that until doses equal, at least, to half a cubic centimetre of the stronger preparations were given, the presence of anti-bodies in the blood could not be demonstrated by means of the "fixation of the complement." This harmony of clinical experience and observations, made by the most exact methods of science, is certainly striking, and if these large doses are necessary in order to turn the scale in favour of the individual, it is clear that months, even many months, must elapse, before the patient can definitely be benefited. If it seems likely that the patient cannot survive the time necessary to work up to these relatively large doses, it may not be wise to institute treatment. Moreover, in the later stages of the disease, it may never be possible to arrive at these large doses, which alone can save the individual.

Even in certain types of individuals, the disease may run such a rapid course that tuberculin cannot be used with any benefit. Sometimes this virulence of the disease is due, not so much to the virulence of the tubercle bacilli, as to the virulence of the mixed infections. A vicious circle is created: the tuberculous process favours mixed infection; mixed infection often favours the rapid extension, and increases the intensity, of the tuberculous process. Mixed infections, however, belong to the relatively late stage in pulmonary tuberculosis, not invariably, but in the great majority of cases. The most reasonable way of dealing with these mixed infections is to prevent the later stages of pulmonary tuberculosis by striving to heal the lung in the relatively early stages. Tuberculin is unquestionably the best weapon of attack, because it leads to healing of the lung by a process of fibrosis, and fibrosis is the most effective barrier against the invasion of the organisms which cause mixed infections.

While it is certainly true, that pulmonary tuberculosis sometimes reaches a relatively advanced stage without the unfortunate victim being conscious of the existence of serious

disease, the great majority of patients usually seek advice while the disease is not beyond the second stage. In many instances, the early warnings of the disease are either overlooked or made light of. Pleurisy, dating back one, or even several years, is a common warning, and, for the most part, is treated lightly because its serious nature is not understood. If medical men believe in the value of sanatorium treatment in the early stages of pulmonary tuberculosis, they should send every case of pleurisy to a sanatorium. This is certainly not the practice, because medical men do not even now give pleurisy its proper name—tuberculosis of the pleura.

This pleurisy, or tuberculosis of the pleura, may be, and often is, merely a manifestation of pulmonary tuberculosis, and, in the majority of cases, when it begins in the pleura it ends, sooner or later, in the lungs. Prolonged quiescence may be a feature of this pleuritic tuberculosis, which does not undergo spontaneous cure too frequently. Very instructive lessons may be learnt from the use of tuberculin as a diagnostic agent in these cases of pleurisy. In my experience, these cases always react to tuberculin because they are tuberculous, and should be treated just as seriously as pulmonary tuberculosis in the early stages.

Hæmorrhage is another warning, which even patients themselves may regard lightly. It is remarkable how often patients say that they have had "a little blood-spitting," and on enquiry they mean they have coughed up many ounces of blood; but the bleeding has ceased, and has not occurred for months and years; so if it should recur, they are encouraged to make light of it because the first attack had no evil consequences. Thus, the state of the lung drifts from bad to worse. A hæmorrhage, introduced or accompanied by cough, amounting to half an ounce of blood, is almost invariably due to tuberculosis of the lungs. Apart from hydatid disease of the lung, hæmorrhage should be attributed to tuberculosis of the lungs until tuberculosis has positively been excluded, and often the only way to exclude tuberculosis is by means of test doses of tuberculin. The positive diagnosis can be made by the discovery of tubercle bacilli in the bloody sputum; but when there is no such evidence, and the signs in the lungs are doubtful, or absent, tuberculin should be used without delay

as soon as the broken vessel has had time to heal.

If tubercle bacilli are absent, and the tuberculin test is negative, then, but not till then, should the rarer causes of hæmorrhage accompanied by cough, be sought out. Hæmorrhage from the throat is such a rare occurrence that I can hardly remember a concrete instance of it, even in 17 years' experience at a large throat hospital. Hæmorrhage from the nose, from the posterior nares, and from the teeth, can be determined at once by proper methods of investigation, and can hardly give rise to confusion. There is little doubt, too, that occasionally hoarseness and loss of voice may warn one of the possibility of tuberculosis. Again, apart from the respiratory tract, there may be symptoms connected with other organs and functions, which are indirectly due to a pulmonary lesion.

Anæmia, nervous symptoms, digestive disturbances, etc., may be the clinical manifestation of a morbid process in the lungs. These symptoms are frequently overlooked and misinterpreted, and they will continue to be misinterpreted until the value of tuberculin in diagnosis is fully and widely appreciated. Vague states of ill-health, especially with marked loss of energy for no obvious reason, may be the mask under which pulmonary tuberculosis conceals itself until it is well established. It is because pulmonary tuberculosis in the early stages may masquerade in the guise of diseases of other organs than the lungs, that medical men are frequently deceived, and will continue to be deceived, until they recognize in practice the value of tuberculin in detecting the real and serious nature and meaning of these symptoms.

The idea still holding possession of the minds of the older medical men in London, that proper doses of tuberculin used for diagnostic purposes are dangerous, is not the only objection raised to the use of tuberculin in diagnosis. We hear it reiterated that in every community so many people, apparently healthy, react to tuberculin, that the value of the test is reduced to a vanishing point. These views are based upon the observations of Franz, not in a crack cavalry regiment of Prussia, but in a Bosnian infantry regiment coming from a district known to be saturated with tuberculosis. Franz states that 61 per cent. reacted to .003 old T., but this did

not fully represent the cases already infected, and it is, therefore, stated that 68 per cent. reacted. Such a high percentage of cases reacting to tuberculin does not accord with my experiences either in Australia or in London.

The only way to discover the frequency of a positive reaction in healthy individuals would be to test a series of cases. At our tuberculin dispensary in London, we test every case that does not yield tubercle bacilli in the secretions. There is no other way of determining the ætiological diagnosis, and the individuals who come to us come because they are ill. The "contacts" stand in a category by themselves, and it is hard to understand how anyone, with clinical experience, can pretend to discriminate between infected and non-infected individuals among the "contacts," without the routine use of tuberculin. Without tuberculin, one can merely indulge in guesses at truth, and the guess is as likely to be wrong as right. I proved this by means of the tuberculin test upon a large number of cases that would have been condemned to sanatorium treatment, if I had not tested them and obtained a negative result.

My experience in London has been somewhat similar. I have tested a number of cases for medical men, and, in many of these cases, the diagnosis of tuberculosis had been made on clinical evidence by the medical man who sent them to me. In the majority of cases, the tuberculin test showed that there was no tuberculosis. These were cases under Drs. Tilley, Haworth, Evans (2), Fell, Cathcart, Williams, Mitchell Bruce, and Parkes Weber. In all these cases, the most likely diagnosis seemed to be tuberculosis, and yet tuberculosis was definitely excluded. The medical profession has still to learn the value of the tuberculin test in excluding tuberculosis in those cases in which tuberculosis is strongly suspected to exist. In Sydney, I proved by means of this test that it was pretty easy to make mistakes in the early diagnosis of pulmonary tuberculosis. The early diagnosis of pulmonary tuberculosis, in which no tubercle bacilli are found in the sputum, can hardly be made with certainty in any other way, and yet many such cases are treated, and recorded as successes when the diagnosis is certainly open to question.

I doubt if any open-minded medical man, who has

watched our work at the tuberculin dispensary for six months, would fail to realize the great value of the tuberculin test in the diagnosis of suspected cases of tuberculosis. He would also learn, better than I can explain in an article, the meaning of a tuberculin reaction. It does not mean only a skin reaction, or a rise of temperature, but it means a very definite, and sometimes severe, disturbance of metabolism, repeating itself in a very remarkable way, often for weeks and months, during the progress of treatment. Further, the remarkable improvement, that follows tuberculin treatment in those cases in which the diagnosis can only be made by means of tuberculin tests, would justify a medical man in using tuberculin, if not to prevent serious and dangerous progress of the disease, at least to restore the individual to normal health and vigour. But these lessons can only impress those who have taken the trouble to watch the administration of tuberculin in a routine fashion, both for diagnostic and curative purposes, at a properly organized tuberculin dispensary.

It may certainly be urged that the tuberculin reaction appears equally in cases of tuberculosis that have a good and a bad prognosis. It may, therefore, be difficult, if not impossible, at the outset to determine in which cases treatment is necessary. No doubt the most successful plan would be to treat all, so that there might be no failures. It may be possible, by a careful study of the sensitiveness of the individual to a succession of increasing doses of tuberculin, to obtain some measure of the resistance of the individual. The very process of tuberculosis is due to a certain affinity of tissue for the toxins of the tubercle bacillus—readily explained by Ehrlich's "side-chain" hypothesis—and, certainly, one would assume that, when this affinity expresses itself in a well-marked reaction to a succession of doses, specific treatment is clearly indicated.

At our dispensary, such phenomena are everyday occurrences in cases, which ultimately reach very satisfactory results under specific treatment. As the sensitiveness is gradually subdued, the individual rapidly recovers health and vigour, and subsequent treatment has a further object in view, that of training the living tissue elements to respond rapidly

to the action of toxins by the over-production of anti-bodies, upon which immunity depends. At first, the anti-bodies may be chiefly anti-toxins, which prepare the way for the destruction of the parasite itself through bactericidal agents, either normally present in the system, or artificially produced in the tissues by specific antigens. In this way, the tissue elements are favorably influenced to subdue the toxic effects of the disease, and finally to destroy the parasite itself. Therefore it is, that large doses are held to be essential, if the goal of our attainment is not merely to improve the condition of the individual, but to place this insidious and subtle parasite *hors de combat*.

Still it must be admitted that this over-sensitiveness, which represents the affinity of toxins for the tissue, may not be very pronounced when the disease is well established with well-marked physical signs of the second and third stages, and numerous tubercle bacilli in the sputum. It is a reasonable assumption that in such cases more or less extensive fibrosis acts as the effectual barrier, and saves the situation ; but in such a condition there is no security, and even apparently quiescent lesions may break through the barrier and lead to extension of the disease, and sometimes generalization, ending in fatal tuberculous meningitis. It is quite certain that early, and apparently innocuous, tuberculous foci, may have this tragic termination. If there is any method which offers a chance of preventing these tragedies, surely we should not ignore it. My own experience seems to show that specific treatment acts in this way.

The extraordinary effect of tuberculin in arresting and preventing hæmorrhage, and the rarity of tuberculous meningitis in cases that have been treated completely with tuberculin, have impressed upon me the view that, properly used, tuberculin causes the lung to heal, and tends to prevent extension of the disease to near and distant parts. Accordingly, if there is evidence, such as a tuberculin reaction alone can give, that a tuberculous lesion exists somewhere, it is prudent and wise to render the lesion inert and harmless. By adopting this principle of action, we may sometimes assist those who need no help, but at the same time we are offering assistance to all who do need it. It is impossible to determine beforehand

what may or may not happen, when there is a living enemy lying in ambush in the tissues. It is better to try and kill the enemy, even though we may wake him, rather than give him the opportunity of choosing his own method and hour of attack.

METHOD OF TREATMENT.

There are many ways of using tuberculin, right ways and wrong ways. The chief virtue of small doses is that they can hardly do any harm. It is otherwise with the system of large doses. Undoubtedly, it is possible to do great harm with large doses, if they are not given in proper sequence and at proper intervals. The doses originally recommended by Professor Koch were not large, and yet disasters frequently happened after their misuse. Similar disasters will be repeated, if tuberculin treatment is carried out in the same way. One must raise this note of warning, when one hears that an attempt has been made at the Brompton Hospital to instruct men in the use of tuberculin by a series of lectures extending over a week. I fully believe that there are not many men who can master the details of tuberculin treatment in three months. Even at the end of three months they may be able to deal with none but the simplest cases. Still, they will learn in this time enough to prevent them using tuberculin thoughtlessly or rashly.

In the specific treatment of pulmonary tuberculosis, the medical man must be able to distinguish the different stages of the disease by physical signs and symptoms. He must also have been trained to read correctly the temperature charts in their varieties and vicissitudes, and he must master the methods of measuring and recording doses. Care and accuracy in these observations cannot be learnt in a week or in a month, and want of care, or inaccuracy, may cause serious trouble. The very progress of the doses, which vary in every case, can only be appreciated by a close and frequent study of a number of charts and records which may extend over eight months to a year.

It is necessary to insist upon this need for special and prolonged study, because the State Sickness Insurance Committee of the British Medical Association has resolved that every medical man can easily become qualified to take his

turn in treating with tuberculin insured persons suffering from tuberculosis. I doubt if one can trust medical men to admit their own limitations, and, in the interests of scientific treatment by specific remedies, one must protest against a decision which can only arise from a very scanty and imperfect knowledge of the real meaning and nature of tuberculin treatment.

If tuberculin is to be used as the essential remedy for treating tuberculosis—and I believe there is no better, more economical, and more effective method—I consider that tuberculin dispensaries must be established for this specific purpose. Treatment is the essential objective of the Insurance Act, and the money contributed by the employers and employees cannot be diverted from this express purpose to subsidiary objects of public health departments. Medical Officers of Health should take no part in the treatment of tuberculosis under the Insurance Act.

By the establishment of tuberculin dispensaries, the primary object of which is treatment by specific remedies, this policy of differentiating the treatment of insured persons from the measures necessary for the protection and maintenance of public health will definitely and deliberately be recognized. From this point of view, my system of tuberculin dispensaries is far better for carrying out the express purpose of the Insurance Act than the so-called tuberculosis dispensaries. It is partly because Medical Officers of Health have dabbled in sanatoria, that they now wish to dabble in the treatment of pulmonary tuberculosis by specific methods.

This special work of treating disease belongs to the practitioner of medicine, who must qualify himself for this work before he undertakes it. There is little doubt that, at the present moment, none but a few general practitioners, and they are mostly my own pupils, are to be trusted with the administration of tuberculin according to the system which I am advocating. Three years ago, I recognized that the profession had no opportunities of studying this method of tuberculin treatment, and in order to help medical men to prepare themselves for this difficult work, I established my tuberculin dispensary in London as a centre for instruction.

The system of tuberculin dispensaries is quite new, and

is the evolved product of my own experience with tuberculin in Australia. I place tuberculin dispensaries in the forefront as the best, cheapest, and most effective means of dealing with tuberculosis among the poor, and the success of my tuberculin dispensary depends upon the skilful use of tuberculin in diagnosis and in treatment. My system of using tuberculin is quite different from the timid and superficial system of the Johns Hopkins University; different from Wright's system, based upon the opsonic index; radically different from Marmoreck's method by means of a serum; and essentially different from Béraneck's system.

In 1890, before the trials with tuberculin in London had lasted six months, many deaths were recorded and attributed to tuberculin. So far at the tuberculin dispensary, although in any series of 200 cases of pulmonary tuberculosis we should expect many deaths, we have only four deaths to record. There must be some vast difference in the method of administration, when the results are so glaringly at variance with one another. Not only my own experience, but the experience of all my pupils, whom I may now count by the hundred, will attest to the absolute innocuousness of the system, if carried out at dispensaries under the simple conditions which I have imposed, even when very large doses are given.

There must be something in favour of my system of tuberculin dispensaries, when, in less than two years, more than forty centres have been established, where they are using tuberculin on my plan. Firstly, the system is free from risk. Secondly, it greatly benefits the patients and soon wins their confidence. Thirdly, each centre becomes a training ground for educating medical men in the general principles of tuberculin treatment. The rapid extension and popularity of the system, wherever it exists, urge me to suggest that tuberculin dispensaries should be started in every populous district.

The test and touchstone of success is finance, and I will briefly give the financial position of the tuberculin dispensary. The amount of money devoted to the treatment of tuberculosis under the Insurance Act is £1,500,000 for buildings, and £1,000,000 for maintenance. Illustrations and arguments appeal all the more strongly when they have a local colouring.

In London with a population of 6,000,000, the annual death-rate from tuberculosis in all its forms is about 8,000 ; that is, about 160 deaths every week, or about 20 every day. We may therefore estimate that in London there are 40,000 persons needing treatment for which they are unable themselves to pay. According to Mr. Lloyd George's scheme, London would be entitled to £200,000 for buildings, and £140,000 for maintenance.

Tuberculin dispensaries can be adapted to the size of the neighbourhood. The cost of buildings is a very small item, as it should be. We rent, for £60 a year, a house where two doctors can easily treat 200 or even 300 cases every year. Thus London would require at least 100 such dispensaries, and 200 doctors to work them. The buildings can best be provided by leasing houses for the purpose. The rent would be covered by the interest derived from the £200,000 allocated to London. Thus the capital remains untouched, so that if the scheme did not work there would be no loss of capital.

With regard to maintenance it must be laid down that money spent under the Insurance Act should be spent upon the *treatment* of insured persons suffering from tuberculosis, and should not be devoted to any of the functions which belong to Public Health Departments. It is a pity that, from the outset, Medical Officers of Health have been encouraged to intrude upon a very important province of practical medicine. Medical Officers of Health have not had the training which qualifies them to undertake the treatment, or even the diagnosis, of the different forms of tuberculosis, and it would be a far wiser policy to establish the special tuberculin dispensaries for the specific object of treatment by competent medical men, instead of organizing the whole scheme under the wing of Medical Officers of Health.

No doubt, some Medical Officers of Health may appoint specially qualified medical men for this work, but in the main the work of treating tuberculosis should be controlled and undertaken at special institutions, so that the money obtained from employers and employees may be devoted to treatment, and not diverted to the purpose of the Public Health Departments. This differentiation of function is a *sine qua non* if the insured persons suffering from tubercu-

losis are to reap to the full the advantages of sanatorium benefit under the Insurance Act. In Germany the departments of public health have nothing whatever to do with the benefits provided for those who suffer from tuberculosis.

At the present moment, Medical Officers of Health, as a body, incline to sanatorium treatment, because they have had no opportunity of personally judging the merits of the system of tuberculin dispensaries. Until I came to London and established these dispensaries, Medical Officers of Health took no interest in tuberculin treatment, because this was a branch of practical medicine quite outside their range of action as Medical Officers of Health. As a body, they are able and ready to embrace the Edinburgh system of tuberculosis dispensaries, because the greater part of the duties of the officers of these institutions really should be undertaken by the Medical Officers of Health themselves.

This digression was necessary in order to explain why I insist that the function of the Insurance Act is to treat, and I unhesitatingly propose the scheme of the tuberculin dispensaries as the only scheme which primarily aims at the treatment of insured persons suffering from tuberculosis. These tuberculin dispensaries not only provide the best treatment, but provide it at a reasonable cost. It is possible to treat 300 patients every year at a tuberculin dispensary, under the direct control of two experts, trained in the methods of tuberculin administration. This work is of a special order, and demands special remuneration.

The chief expert need not be, and better, should not be, a whole-time officer. The more experience a man has in general practice, the better qualified he is for this work, provided he has thoroughly mastered the methods of tuberculin treatment. I consider the chief expert in such work is well worth £500 a year, and the junior expert should have £300 a year. The rest of the expenses need not exceed £250 a year, so that each self-contained tuberculin dispensary would cost about £1,000 a year for maintenance, and for this sum 300 patients could be treated. I venture to think that no other scheme can offer such favourable terms to the unfortunate victims. Moreover, on such a basis Mr. Lloyd George's fund of £1,000,000 a year for about 300,000 cases

very accurately provides the exact sum necessary for the maintenance of tuberculin dispensaries.

There is a further feature in this proposal which should appeal to medical men. According to my suggestion £750 out of £1,000 spent upon treatment is paid to the medical men whose skill and knowledge alone can help the patients. This literally means that, if the money provided by the Insurance Act be spent in this way, the cost of the medical services amounts to no less than £750,000 out of £1,000,000. If the treatment is of the best, if the cost of treatment is no more than £3 or £4 per case, and if the bulk of the money is spent on actual medical services, surely the interests of all parties, of the patients, of the taxpayer, and even of the doctor himself, are thoroughly and duly considered.

Provided there is a large supply of medical men competent to carry out treatment under this system, the remuneration to the Profession may gradually be distributed among a larger number, but I do not hesitate to say that the scheme of tuberculin dispensaries would not only fail, but end in trouble, and even disaster, if at the beginning the mistake were made of imagining that *medical men were themselves to be the judges of their own competence to carry out a method of treatment, which can only succeed in the hands of men possessing special knowledge, special skill, and special experience.*

The State Sickness Insurance Committee can have little knowledge of the requirements indispensable to the successful treatment of tuberculosis by specific remedies, if they imagine that this highly specialized work can be undertaken by any group of medical practitioners working in routine. Bad work in the past discredited tuberculin, and such a system as that suggested by this Committee would inevitably lead to even worse results than those which culminated in the utter condemnation of tuberculin treatment twenty years ago. The decision of the State Sickness Insurance Committee cannot be reconciled with any real, first-hand knowledge of the work of tuberculin dispensaries, and the interests of medicine and medical men demand a close and judicial investigation of any system which promises more than any existing scheme for dealing with the problem of tuberculosis among the poor. By ignoring a system, the Committee dares not condemn or

praise. It must investigate before it can decide.

If medical men seriously think of undertaking this highly specialized work, they must prove themselves competent craftsmen. It is no easy matter to learn the proper use of tuberculin, even in diagnosis, far less in treatment. I consider that anyone, undertaking this method of treatment, should have worked about ten hours a week for three months at a properly equipped tuberculin dispensary, if he wishes to undertake work on his own responsibility. This alone can teach him the chief principles upon which treatment by means of large doses can successfully be carried out. Even then he should confine himself to relatively simple cases for another six months, and the longer he studies the method, the more convinced he will become of the truth, that the steps which lead to the high altar of success are many, steep, and difficult to climb.



TREATMENT OF TUBERCULOSIS AT THE TORQUAY TUBERCULIN DISPENSARY.

By R. ALLAN BENNETT, M.B., M.R.C.S., L.R.C.P.

THE following description of a small, private, tuberculosis dispensary, which has been worked in Torquay during the past twelve months, may be of interest just now, when the larger enterprises of the various county schemes are starting. The necessity for private institutions of this sort is probably past, at any rate in the large towns, but in country districts, where the working of the national scheme may be difficult, it is possible that for some time to come there will be room for them.

The dispensary is run on the following lines:—

- (1) There is no cost of any kind to the patient.
- (2) Patients in all stages of the disease are taken, but they are only accepted when sent by a medical man, or when they have not been under any treatment for six months before applying.
- (3) There is a health visitor who calls on the patients at their homes, advises them as to their way of life, and reports on those who are not in a position to obtain proper nourishment.
- (4) Arrangements are made to supply the very poor with milk and other necessities.

During the twelve months, 74 patients have been treated, and the whole cost of the experiment amounts to 80*l.*, which works out at about 1*l.* a head. This covers rent and taxes, furniture, drugs, tuberculin, and stationery; the health visitor and the nurse in attendance at the dispensary give their services, and the supply of milk, &c., is arranged by two ladies who are interested in the scheme.

The routine of work is carried out in this way. Patients suffering from obvious pulmonary tuberculosis are given a thermometer, told to take their temperatures four times a day, and instructed to report again in a week. During the interval the sputum is examined, and in cases in which T.B. are

found, and other circumstances—chiefly depending on the temperature—are favourable, treatment is begun at once.

In all other cases, the diagnosis of tuberculosis is made by a series of injections of old tuberculin, and no patient is accepted for treatment, unless he has T.B. in his sputum or gives a definite reaction to T.O.

The diagnostic injections are made on a regulated scale. The tuberculin used is diluted 1 in 100; the syringe is the Record syringe made by the Medical Supply Association, 1 c.c., graduated in fiftieths and tenths of a c.c. Thus, one large division = .001 c.c. of T.O. of this dilution, and the smaller divisions allow of a perfectly accurate dose being given.

In practice the first dose to an adult is .002 c.c., and this is doubled after an interval of two days. The dose is again doubled with the same time interval, and this is continued until a reaction occurs or the maximum dose is reached without a reaction.

The tuberculins used for treatment are P.T.O., P.T., and T.R., and the dilutions are, of P.T.O. and P.T. 1 in 1,000, 1 in 100, and 1 in 10; of T.R., 1 in 10,000, 1 in 1,000, and 1 in 100.

At first, I attempted to push the dose as much as possible, beginning, for example, with .001 c.c. P.T.O. and doubling the dose twice a week. In this way I repeatedly obtained reactions, some slight and some severe, but after following this plan for some weeks, I formed the opinion that these reactions were injurious to the patients, who, I should say, were chiefly persons following their employment during the treatment. Now, I hold the view very strongly that it is unwise to give a dose large enough to produce a reaction, and if a reaction occurs, I diminish the dose, or lengthen the time interval between the injections.

This method is, of course, in direct opposition to that followed by many experts, who prefer to push the dose as rapidly as possible to the absolute maximum, and either ignore a mild reaction, or at least do not look upon it with any degree of fear. I believe, however, that it is the correct one, and it can certainly be defended on several lines. In the first place, all tuberculins contain toxins other than the specific one, on whose action the idea of the treatment is based,

and it is impossible, in cases in which a reaction occurs, to assign to one or the other toxin its exact share in the production of that reaction. The question of prolonging the duration of the treatment does not appear to me to weigh against the greater safety of this method. Practically, every person suffers at one time in his life from tuberculosis in one form or another. Nature effects a cure in the vast majority, and this without the production of reactions in any form. Finally, the reactionless method of treatment satisfies the greater of the two essential objects of all forms of treatment—"that the drug shall do the patient no harm."

The patients who have attended this particular dispensary have been under treatment for so short a time, that no question of cure can be raised in respect of them, but the results have been tabulated, and they are sufficiently good to encourage one to continue the work with hope, and even with enthusiasm. The results of the cases that have been under treatment long enough to enable one to form an opinion on them, are as follows:—

(1) Improved	-	-	-	-	38
(2) Stationary	-	-	-	-	22
(3) Worse	-	-	-	-	5
(4) Died	-	-	-	-	4

In considering these results, it should be remembered that every case that came to the dispensary was accepted. All the patients under headings 2, 3 and 4 were suffering from advanced pulmonary tuberculosis—three of the patients who died, were in the last stages of the disease when they came to the dispensary, and the fourth developed tubercular meningitis a fortnight after the treatment had begun.

The patients described as improved, are those who gained weight, who lost their cough, whose sputum diminished in quantity or entirely disappeared, and who have been able to continue their work with renewed energy and vigour. Four of these patients—all in the third stage—have not lost a day's work in the twelve months, and in seven, tubercle bacilli have disappeared from the sputum.

The great difficulty in the working of the dispensary was the want of any hospital accommodation for those patients who, often too ill to attend the dispensary, were unable to

obtain reasonable conditions for treatment in their homes. Time after time, in cases which have to be classed under headings 2 and 3, one felt that, if it had been practicable to send them to a hospital for a shorter or longer time, it would have been possible to improve their general condition, and so allow the action of tuberculin a better chance. Under the Act this will become possible, and the time will come, when cases, which now no sanatorium will accept, will have access to treatment, which if it cannot cure the patient, will ensure him decent care, and at least teach him, when he goes home, how he can become less of a danger to his fellow creatures than he is at present.

In concluding this short communication, it may be of interest to speak of the result of the treatment as it appears to me personally, for it is only by the consideration of individual opinions based on results that one can hope to throw light on the whole problem. I remembered the enthusiasm with which tuberculin was received 20 years ago, and I remembered the disappointments and disasters which followed, and its gradual abandonment by all but a very few of the faithful. For the last few years, I had used tuberculin, but always tentatively and always with a lively fear of its possible effects before me. The controversy in the medical papers last year revived the interest I felt, but still I could not banish the fear of tuberculin from my mind, and I began work with a bias against it. The first few weeks did nothing to remove this feeling, but as soon as I abandoned all attempt to hurry matters, and was content to make the treatment reactionless, the feeling of opposition died away, and now I feel quite convinced that tuberculin is of the very highest value in the treatment of the disease—that every doctor who is engaged in the anti-consumption crusade should use it and that it should take its place with sanatoria and isolation hospitals and the rest.

It is of course impossible to expect that every case of tuberculosis will obtain benefit from tuberculin. The individual comes into consideration here, just as he does in all other forms of medical treatment, but I believe that, in the vast majority of cases, tuberculin will not disappoint, and if it does, the fault must be looked for in the manner of using it.

THE SURGICAL TREATMENT OF TUBERCULOSIS.

By SIR ALFRED PEARCE GOULD, K.C.V.O., M.S., F.R.C.S.

Senior Surgeon to the Middlesex Hospital.

THERE are only two methods of treating tuberculosis wherever it occurs. One of them is of universal applicability, and should never be dispensed with; the other is only occasionally indicated as an adjunct to the first, and not as a substitute for it. The former consists in the development and the maintenance of those protective powers against the tubercle bacillus, which enable the healthy to withstand the invasion of this disease, and, in a large majority of those attacked, gradually and successfully upset the invader. The latter consists in the removal of tuberculous deposits—granulation tissue, caseous deposits or the results of the liquefaction of these, the so-called “cold,” “chronic” or tuberculous abscesses—together with the living infective tubercle bacilli. The one concerns itself with physiological processes; the other chiefly with mechanics, sometimes with chemistry. The one is constructive and aims at re-establishing a normal condition of nutritive activity, a healthy condition of cells and serum; the other is destructive, or, at least, scavenging, and its details concern the completeness of its processes of removal, and the limitation of the accompanying injury to healthy parts, within the narrowest limits.

Different as these two methods of treatment are in their aims and means, it is important to remember that they are closely complementary. Thus, when the physiological forces of the body are unable to cope with the invading tubercle bacilli and their granulomatous products, the mechanical removal of these—or the bulk of them—may at once enable the organism to protect itself against any further invasion, to remove or to imprison and sterilize residual bacteria, and to maintain sound health. On the other hand, the mechanical or chemical removal of tuberculous deposits is never complete, some tubercle bacilli are probably always left behind, even after the most “radical” operation, and it does nothing directly

to build up the protective cells and sera upon which immunity from re-infection depends. They are not, therefore, opposing methods of treatment, not even alternative modes, but strictly complementary.

For convenience we may dub them the "medical" and the "surgical" treatment of tuberculosis, but the physician carrying out his medical treatment should remember its limitations and familiarize himself with the scope of surgical intervention and its possibilities, and should be alert to recognize the need for it. While the surgeon, in practising his art in any case of tuberculosis, must ever be keenly alive to its limitations and realize that its success in every case depends upon the activity of those protective agents, which it is the aim of physicians by their medical measures to invigorate. To put it in another way, we may say that all cases of tuberculosis must be treated medically, and that the need for medical measures is never more urgent than when a case requires some operative interference to complete the cure. The details of the two methods of treatment are different, and in many cases they are carried out by different individuals bearing differing technical names, and so we are apt to look upon them as having no connection one with the other, and as rivals rather than colleagues. We may still find a physician and bacteriologist who seems to have no need of a surgeon, and a surgeon so confident in his art that he spurns the aid of a physician. Success is in their wise co-operation.

But no stronger evidence of the confusion still existing on this point is needed than that afforded by the Sanatorium Clauses of the National Insurance Act, and the discussions thereon. From these one would suppose that there are no cases of surgical tuberculosis at all, or that if there are, they do not need those special aids to the establishment of immunity from the disease that the victims of medical tuberculosis must chiefly rely upon. Accordingly, when a Committee was recently appointed to consider the provisions of sanatorium treatment, it was not thought necessary to add a surgeon to the physicians and bacteriologists who formed the expert part of that body. Those responsible could not have realized that surgeons have as much to do with tuberculosis as physicians, and that in every case in which a surgeon has to treat tuber-

culosis, the success of his treatment depends entirely upon his ability to combine with it the best and wisest medical measures.

Clearly appreciating that surgical measures are only to be adopted as an adjunct to medical treatment of tuberculosis, and when these are unable alone or within a reasonable time to be efficient, we must now deal with these surgical measures more in detail.

1. The first is *Evacuation of a Tuberculous Effusion*.—There is only one case in which this is attended with striking success, and that is in tuberculous ascites. In this disease, an incision into the peritoneal cavity and the complete removal of the effusion, without removal of any primary focus of the disease and without drainage, are attended with great success.

The operation is one of the simplest, but it must be done with every known precaution against infection. In a few cases, it may be wise to excise a tuberculous appendix or Fallopian tube, if it is gravely and especially diseased; but, as a rule, tubercles in various stages are found scattered so broadly or even universally over the serous surface that no local removal is indicated. Occasionally, the operation has to be repeated. In every case it must be combined with the most careful and thorough medical treatment, of which prolonged rest in the open air is the most important factor.

The simple evacuation of a tuberculous abscess is not a good procedure, and can only be justifiable under some very special circumstances, and then only as a palliative measure.

2. The *removal of a Tuberculous Deposit* is the most usual and the typical surgical treatment. It can be effected in two ways. In many cases, the disease attacks an organ or part that is enclosed in a definite fibrous capsule, such as a lymph-gland; in others again, the disease excites fibrous hyperplasia around the developing tubercles, and in this way a delicate or a firm fibrous wall is formed surrounding the diseased area. In such cases, the best method of removal is the careful excision of the encapsuled tuberculous mass or masses, without puncture or encroachment on its capsule. In doing this it is important to remember that the fibrous capsule of a tuberculous deposit is always more or less firmly adherent to the tissues around it, and can never be “shelled

out" from them, and when it is altogether new-formed it is always very thin and delicate. And so it comes about that this operation always requires care, and may be extremely difficult—even impracticable.

Glands are so often in close proximity to important vessels and nerves, that the dissection out of a tuberculous gland, which has become abnormally adherent, without wound of vessel or nerve, often requires much care and patience, especially patience. The surgeon should define at some convenient spot the outer surface of the original capsule of the gland, and then by slow dissection with gentle touches with the point of a sharp knife—not by blunt dissection—without anything more than slight traction upon the gland, he should endeavour to separate the gland from the tissues around it. On the other hand, when dissecting out a tuberculous abscess which has developed its own fibrous wall, no traction at all must be made upon this latter—it is too slender to bear it—and a sharp knife must be used to sever the tissues around it.

The existence of a fibrous wall around a tuberculous deposit enables the surgeon to use another method of effecting his object, and that is to scrape or rub from within this capsule all the tuberculous material. This is evidently a less certain means of removing every trace of the disease than is the method of excision; it should be employed when excision is impracticable, and always with that thoroughness and care that the realization of its difficulties alone gives to the surgeon. It cannot be done through a mere puncture, but a good free incision should be made through the fibrous capsule—the freer the better—and the cleansing of the inner surface of this capsule should be done systematically, so that no portion is omitted, first with a blunt spoon, and then by rubbing aseptic gauze over the surface. When no further granulation tissue can be removed, it is a good plan to swab over the surface with solution of adrenalin, and the wound made to expose the diseased part should be closed with special care. If possible, each layer of fascia, and divided or displaced muscle, as well as the skin, should be readjusted and fixed by sterile sutures, the object of this care being to protect the diseased part from infection through the wound.

I may refer to three tuberculous conditions, which can well

be treated, by this means. The first is caseous and softened glands, inseparably adherent to important structures. Such a case presented itself to me last spring in a servant girl, admitted into Middlesex with symptoms of sub-acute appendicitis, in addition to which there was a lump the size of a Tangerine orange in the centre of her abdomen, which, she said, she had noticed for some months ; this lump was a little movable in all directions, and was when I saw her a little tender. I was unable to make a precise diagnosis—it might be a mass of infiltrated adherent omentum around the tip of a long diseased appendix, or quite an independent condition.

I operated, and having first removed an inflamed appendix, then exposed the lump, which turned out to be a very large softened gland in the mesentery of the ileum, and the only diseased gland I could see. I tried to dissect it away, but after a patient trial found it impossible to separate it from the numerous and thin-walled vessels of the mesentery—to persist in the attempt would not only have been to excite hæmorrhage difficult to arrest, but would have certainly imperilled the vitality of a considerable length of the ileum. So I made the freest incision I could into the softened mass, and then, first with blunt spoon and then with sterile gauze, removed the contents, and cleaned as carefully as I could the fibrous wall ; it was an irregular and pouched cavity, and it needed care to follow up all the irregularities of the surface. The patient made an excellent recovery, and nothing more was felt of the lump, but I advised her to have some months of rest in the open air before resuming her work.

The second condition for which this treatment is especially applicable is that of a psoas or iliac abscess ; it is impossible to dissect out these abscesses, but a great measure of success attends this other treatment if carried out with due thoroughness and care. On no account should such an abscess be drained, even for a day or two, lest infection occur or an intractable sinus persist. The cavity sometimes fills up again quickly with blood-stained serum, this should be drawn off with an aspirator. If it fills up more slowly, or if an exploratory puncture shows that the fluid is turbid and tuberculous, the operation should be repeated with even more care than at first ; failure to obtain cure is rare.

The third condition, for which this mode of treatment is particularly indicated, is a tuberculous focus in bone, which has not cleared up under such medical measures as prolonged rest in the open air, careful diet, and tuberculin. A good skiagram should always be obtained in such a case, that the surgeon may see beforehand the position and extent of the deposit he has to remove. Here, again, one secret of success is to make a sufficiently free opening into the diseased focus, so that the scraping away of the tuberculous area can be done under proper mechanical conditions. Failure has often resulted from the surgeon attempting the impossible task of removing a large area of disease through a puncture; it would be as sensible to ask a housemaid to clean out a room through the keyhole in the door!

3. *The amputation of the diseased part* is the other great surgical method at our disposal. It differs from the preceding method in removing not only the products of tuberculous disease—granulation tissue, caseous material, and abscesses—together with the living infective tubercle bacilli, but in sacrificing more or less healthy and uninfected tissue as well. The nature of the operation is the same whether it be an excision of a joint, an amputation of the limb, or the removal of a tuberculous kidney, testicle, or breast. In all alike, the surgeon, unable to remove only diseased tissues, secures his end by the sacrifice of certain healthy tissues as well.

Forty or fifty years ago, surgeons were full of enthusiasm for what they called "conservative surgery," and the pages of contemporary periodicals were full of addresses and articles on the subject; the special example being the great value of excision of joints in place of amputation. Those of us, who are old enough to remember the surgical practice of those days, will understand the enthusiasm for any substitute for the then too frequent amputations, but it is easy to see that the underlying principle of the two operations is the same, the sacrifice of healthy parts in the removal of diseased structures; the difference between them is one of degree only.

The justification for this method of treatment lies in two conditions which are often combined, though one may exist alone. In some cases, the disease may have involved so much of an organ or part that its removal may not leave

useful structures behind; and, in addition to the main foci of disease, there may be such wide surrounding infection that removal of these foci will surely be followed by further development of tuberculous disease. These are the two conditions, of at least one of which the surgeon must satisfy himself, before he resorts to amputation of the diseased part; and because amputation is always so much more easy to effect, and is *ex hypothesi* more certain of success than mere removal of diseased tissues only, the surgeon must be at special pains to assure himself of its absolute necessity before he resorts to it. The greater mutilation of the amputation should always ensure the greatest caution before deciding to resort to it.

We will conclude this short article by considering this treatment as applied in two situations. First of all, *the testicle*. When the disease is limited to the epididymis, and that is converted into a cheesy mass or a softened tuberculous lump, the epididymis only should be excised, together with the whole length of the vas deferens. Care must be taken not to injure the vessels of the cord, or their branches connected with the body of the testicle. Enlargement of the vesicula seminalis and prostate is not a bar to the success of this operation, but it affords an urgent reason for prolonged and careful medical treatment. It is very instructive to watch the gradual recession of these secondary tuberculous foci after the removal of the primary seat of disease, when, up to the time of that operation, the disease had steadily progressed in spite of careful treatment.

The body of the testicle without epididymis and vas deferens has, of course, lost one of its functions—the procreative—but it retains the more important virile function of its “internal secretion.” Should the disease have advanced further and spread from the epididymis into the body of the organ, no partial operation will be of avail, but the testicle should be removed, and the vas deferens separated as high as possible. If the incision is made over the external abdominal ring, and the ring is enlarged outwardly, it is possible by blunt dissection to separate the vas deferens from the iliac vessels and the peritoneum, and either to tear or cut it away quite close down to the prostate. The considerations that guide the

surgeon in choosing between epididymectomy and castration, or in deciding to operate at all in tuberculous disease of the testicle, are unaffected by the fact, if it is a fact, that the patient has had the opposite testicle operated upon for the same disease.

Second, *the kidney*. Tuberculous disease of the kidney is a very serious affection, first, because it is very liable to involve a wide extent of the organ from an early stage; then because it is so often bilateral; thirdly, because of the vital importance of the excretory function of the kidneys; and lastly, because of the tendency of the disease to spread to the bladder. Before any operation upon a tuberculous kidney is decided upon, it is absolutely necessary that the functional activity, at least of the opposite organ, should be established by the chemical analysis of the urine obtained by ureteral catheterization, and if this urine can be shown to be free from tubercle bacilli, all the better. The presence of tubercle bacilli in urine, which contains a proper proportion of urea and is free from pus, does not contra-indicate operation upon the opposite kidney.

Many attempts have been made to deal with tuberculous nephritis by excision of the diseased pole of a kidney or of one or more tubercular foci, but the result has not been satisfactory. With very few exceptions, there has been a speedy recurrence of disease, and the practice of most surgeons is to excise the kidney in its entirety. It is not necessary to excise the whole extent of the ureter, still less to remove any part of the diseased bladder wall. The best plan seems to be, to isolate the ureter down to the brim of the pelvis, and to place a ligature around it just above that level. Then through a fine needle passed into the ureter below this ligature, to introduce about ʒss. of liquid phenol, ligature the ureter again below this needle puncture, and divide the ureter between the ligatures, carefully sterilizing the cut end with the cautery. Just as in tuberculosis of the testicle and seminal vesicle, disease of the latter often subsides after removal of disease in the testicle, so in tuberculosis of the kidney and bladder, the disease in the bladder often subsides after removal of the diseased kidney, if the patient is as carefully treated as he should be after every operation for tubercle.

TUBERCULOUS DISEASES OF BONES AND JOINTS.

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THE treatment of any condition of disease in or about a joint brings us in every case face to face with two distinct problems. One is the treatment of the specific cause of the disease; the other is the prevention and treatment of deformities and impairments of mechanical function, which may arise in consequence of the local manifestations of the disease.

As an orthopædic surgeon, I am most directly concerned with the discussion of the second of these problems. I may say at once, that the fundamental principles of treatment, directed to preserving the function of diseased joints, are the same for such conditions as chronic rheumatism, "rheumatoid arthritis," and "osteo-arthritis" as for tuberculous disease, and I shall have to refer to these conditions when dealing with differential diagnosis.

While it is quite correct for the physician and pathologist to treat these conditions by therapeutic measures, directed against the particular organism or toxin which produces them, it is my experience that they are too prone to regard the structural changes in the joint as inevitable.

The necessity for guarding and protecting tuberculous joints from all strain and injury has so long been accepted as part of the surgical treatment indicated, that it seems superfluous to labour this point. In recent years, however, I have on many occasions been called upon to deal with tuberculous diseases of joints or of the spine, in cases in which an enthusiastic believer in the efficacy of tuberculin has entirely omitted any form of protective fixation; it is, therefore, necessary to express my strong conviction that this is a serious error. The effect of a course of treatment with tuberculin is to raise the patient's resistance to the bacillus and its toxins, but this is a gradual process. In the meantime, there is an actual pathological condition of the tissues about the joint. If the cancellous tissue in the ends of the bones

is affected, the lime salts are reduced, the whole internal structure of the bone is altered and weakened, and, even if recovery takes place, the repair in these tissues must be in accordance with Wolff's law, and the joint will recover with adaptation to an erroneous position; that is to say, that so-called "cure" takes place with a deformity of the limb which might have been prevented. From the orthopædic surgeon's point of view, this cannot be considered a "cure."

In the next place, the neglect of protective fixation is unfair to tuberculin treatment, for repeated injuries to the diseased structures caused by movement delay, if they do not prevent, the beneficial action of the immunizing treatment. I am repeatedly asked to see cases which are or have been under treatment with tuberculin, because the visible increase in deformity is shaking the parent's faith in the treatment. In a case of caries of the spine, it must be very difficult to persuade a parent that all is well if his child is visibly becoming more hunchbacked.

The most important classification of cases of tuberculous diseases of bones and joints depends on the age of the patient. Children under 15 possess a very high degree of natural immunity, and, when put under proper conditions, tend to recover. In adolescents and adults, the disease presents a very different clinical picture, and therefore may require different treatment.

In the case of a child, operation is hardly ever necessary. When cold abscesses become large or approach the surface, they should be evacuated by tapping or puncture with a tenotomy knife. I make no effort to clear out the contents by scraping, for I have too great a dread of the terrors of mixed infection, and experience has shown that, after tension has been relieved, absorption takes place, in many cases rapidly. In cases in which serious septic infection has already occurred, it may be necessary to amputate to save the patient's life; but an effort should always be made not only to save the limb, but to save the joint. In these cases, the septic arthritis takes precedence of the tuberculous element, and vaccines, prepared from the organisms found in the pus, are often of great value in helping to eliminate the septic element, and even in preserving the movement of the joint.

The fact, that even cases of purely septic arthritis frequently recover with movable joints, does not receive the general recognition that it deserves. The most careful fixation is necessary, from the beginning, to give the joint a chance of recovery with movement. It must be remembered that vascularization of all the neighbouring tissues is an essential part of inflammatory reaction. When articular cartilage takes part in this process, it becomes red, soft, velvet-like in appearance, and is very easily rubbed off by friction. Once it has been destroyed, the liability to bony ankylosis is much increased.

Hilton's classical work on *Rest and Pain* has, I believe, been allowed to go out of print. This seems to be a serious loss to students of surgery, for there is no case in which the principles he inculcated are of more importance than in diseases of joints. While speaking of the articular cartilage, it is a noteworthy fact that it takes little or no part in a purely tuberculous process. It may be undermined and separated from the underlying bone, parts of it may undergo a species of necrosis and allow tuberculous products to escape into the joint, but it is slow to participate in any active reaction. I believe, as the result of clinical experience, that ankylosis which results after a purely tuberculous lesion is almost invariably fibrous, and that bony ankylosis is usually the result of a mixed infection, or of destruction of the cartilage by friction.

The tubercle bacillus is to be regarded as an irritant of very low intensity, and gives rise to little of that vascular reaction, which is so characteristic of infections by the more irritant pyogenic organisms. Tuberculosis is for this reason a disease characterized by slow and insidious onset and progress, and an equally prolonged and tedious process of repair. Holding these views on the nature of the disease, and on the high natural immunity of children, I am a firm believer in the efficacy of conservative treatment in young subjects, and never operate with a view to removing the focus of disease, except in those rare instances where a focus is isolated in the centre of bone; hence, a set excision of a joint for tuberculosis is unknown in my practice. In the case of a serious mixed infection, opening up the joint and clearing out all purulent tissue, and then fixing the joint in the position in which the limb will be most useful

when ankylosed, involves less sacrifice of tissue than a set excision, which can hardly ever be performed through healthy tissue. Late operations on joints which are ankylosed in bad position, of course, belong to quite another category, for they are performed to correct deformity, not to remove disease.

The principles of treatment on which I rely in the treatment of tuberculosis of the joints and spine are :—

1. Complete physiological rest.
2. Good nourishing food, special importance being attached to butter, dripping, jam, and sugar, with an unlimited allowance of good milk.
3. Fresh air.
4. Sunshine.

Provided the children are kept in the open air and get as much sunshine as is permitted by our climate, there is seldom any trouble about getting them to eat, for they always have good appetites.

In earlier years, I treated many of these cases in hospital, but found that they throve much better if they were treated as out-patients. The parents were then instructed to carry the child out into any convenient open space and leave him there all day, and to see that his bedroom window was wide open at night. About ten years ago I was invited by Miss Hunt to visit the open-air hospital she had established at Baschurch. My experience of treating children there in the open air, day and night, summer and winter, soon convinced me that treatment as either an in-patient or out-patient of an ordinary general hospital was quite inadequate to produce the best results. Within the last seven years, the Royal Liverpool Country Hospital has been built at Heswall, and more recently another Home, on the lines of that at Baschurch, has been opened at Eastcote, near Pinner. In all these, the patients receive continuous open-air treatment, regardless of weather, with the most satisfactory results.

I have placed physiological rest of the joint first in the list, because I believe that without this all other methods are of little avail. As I have already shown, absolute fixation prevents deformity. Movement of a tuberculous joint means an increased output of toxin into the circulation, in addition to

damage to diseased structures. In consequence of this auto-infection, there is a subsequent reaction ; the temperature rises, the patient feels ill, loses weight, sleeps badly, and his stock of energy is reduced.

The idea, that by using the joint the patient will give himself immunizing doses of his own tuberculin, is not borne out by clinical experience. It is further interesting that, in the treatment of pulmonary tuberculosis by injections of tuberculin, many authorities hold that, in the early stages of treatment at least, the best results are obtained by "crossing" the tuberculin in the sense that cases of human tuberculosis should be treated with bovine tuberculin and vice versa. If this belief is well founded, care should be exercised in selecting the tuberculin for treatment by injections, for surgical tuberculosis is more often "bovine" than "human," although pulmonary phthisis is almost invariably "human."

The earliest symptom of tuberculosis of a joint is usually impairment of function. A child with tubercle of the hip limps before he begins to complain of pain. Similarly, impairment of the range of movement is a much more certain sign of arthritis than pain. Indeed, one may go further and say, that if there is arthritis every movement of the joint is limited. If movement in any one direction is free and unimpeded, the case is certainly not one of arthritis, and the cause of the impairment of movement in other directions must be looked for outside the joint, and may be found to be an injury of a muscle, or of the attachment of its tendon to the bone, adhesions, a bursitis, or some change of shape in the bone, such as *coxa vara*.

Having established the fact that every movement of the joint is limited, we are entitled to diagnose an arthritis, that is to say, that there is an active pathological process involving one or more of the structures taking part in the formation of the joint, in consequence of which the muscles have reflexly gone "on guard." The only exception to this rule is found in some of the obscure and very chronic forms of synovitis with effusion, some of which react to tuberculin, and must, therefore, be regarded as tuberculous. We need go no further in the direction of diagnosis before deciding on treatment ; the muscles are trying to protect that joint, and it is our duty to fix the joint and relieve the patient

of the nerve-muscle strain, which is very real and very wearing, even though it is reflex and not conscious.

Assuming that the vague history and insidious onset suggest tuberculosis, the next factor in diagnosis is the temperature chart. If the part under suspicion is the spine, or a joint in the lower limb, the patient is in bed with an appropriate fixation apparatus. A sub-normal morning temperature of $97^{\circ}\cdot5$ or less, with an evening temperature of 99° , is practically pathognomonic of tubercle. A higher temperature of 100° or more suggests a septic infection, which may be simple, or complicating a tuberculous lesion. If the evening temperature is not high enough to suggest a septic infection, and the morning temperature is not sub-normal, then the case is probably the result of trauma, and is simply a contusion of the joint, a condition which will be described below.

The case I am now considering is, of course, one which is not sufficiently advanced to show any characteristic "boggy swelling." In such an early case, two or three weeks of physiological rest may be sufficient to allow all symptoms of pain, swelling, and impairment of movement to disappear. Once more the practitioner is assailed with a doubt whether the case is one of tuberculous arthritis or merely the result of trauma. A simple clinical experiment will settle the point whether the joint has had sufficient rest. Let the splint or fixation apparatus be taken off, and then allow the patient to use the joint for two or three hours. If the range of movement is not diminished, he may be allowed still greater freedom. If, on the other hand, he is unduly tired, complains of pain or discomfort about the joint, finds that the joint is getting stiff after exercise, and if there is a sharp reactionary rise of temperature, then there is still an active process going on in the joint.

To make an absolutely exclusive diagnosis, the only means I know in these early cases is the employment of a test dose of tuberculin, and that can only be taken as convincing when there is a definite focal reaction in the afflicted joint. I have placed the tuberculin test last, just as in the diagnosis of fractures I place an X-ray photograph last, as a final court of appeal when all clinical means of diagnosis are exhausted. It is a mistake in either case to use these final means of diagnosis too soon, for by so doing we are

apt to blunt our clinical sense and may be led into error.

An error of this kind may easily be made when dealing with traumatic arthritis, the result of a contused joint. Perhaps, the best instance which I can give to illustrate this condition is the contusion of the shoulder joint, which is produced by a fall on the hand, and is frequently associated with Colles' fracture. At the time of the accident, the patient makes no particular complaint about the shoulder joint. Two or three weeks later, he begins to complain of pain and stiffness in the region of the shoulder. The diagnosis made too often is "rheumatism," and the patient goes on using the joint in the hope that it will pass off. Instead of improving, stiffness increases, and in the course of a few weeks the question of tubercle arises. If a tuberculin test be tried, it is found to be negative, and once more "rheumatism" is diagnosed. I generally see these cases after the pain and stiffness have lasted four weeks or more, that is, six or eight weeks after the injury. Examination shows that every movement of the shoulder, including rotation, is limited. This at once establishes the diagnosis of a lesion of the joint itself, and the necessity for physiological rest. At this stage, rest for three months is usually necessary for complete recovery ; if the joint is rested, in the first instance, three weeks is enough.


The explanation of this condition is very simple. At the time of the accident the cartilage of the shoulder joint was crushed by the impact of the humerus on the glenoid. Cartilage being a non-vascular structure, like the cornea, cannot undergo repair until new vessels have grown into it. In the case of injury to the cornea, corneal ulcer, for example, the whole process is visible : injection of the vessels of the sclerotic, growth of a leash of vessels from the corneo-sclerotic margin to the ulcer, and then repair takes place. A similar process occurs in articular cartilage which has been injured ; it takes some time for the growth of new vessels to take place, and it is only then that the cartilage becomes soft and tender, and pain is complained of.

Finally, some clinical test of recovery is required. This has already been indicated. If the surgeon believes that the joint has been kept at rest for a sufficiently long time, then he may allow the patient some liberty of movement ; if this

is not followed by increased stiffness, but by increased mobility, then the freedom of movement may steadily be increased with safety; but if the muscles once more go "on guard" and the joint becomes stiffer, it is a sure sign that repair is not complete.

While these lines may safely be followed in all cases, even if sinuses exist, experience has proved that in adolescents and adults, the natural immunity of the patient is not so great as in children. The disease is not arrested so rapidly, destructive changes are greater and repair is more tedious. In the hip joint, for instance, sinuses are prone to persist, and, if the patient is not improving in general condition, I am sure that, in many instances, the best thing is to remove the carious head of the femur at least, but I do not invariably advocate extensive operation. Even in adults, I am inclined to be more conservative in the treatment of the knee and elbow. In some of these cases, which seem to come to a standstill after beginning to make progress, a course of tuberculin sometimes leads to rapid improvement.

With regard to tuberculin in joint lesions, I am not yet prepared to give a definite opinion. In children, my results are so good already that it is not absolutely necessary. In adolescents, its systematic use ought to be of great advantage. The problem, however, is not simple. There is the question of the kind of tuberculin suited to each case. Then there is the question of dosage, the results of minute doses given at regular intervals have not proved convincing. In the case of pulmonary tubercle, there is a school which advocates pushing tuberculin up to large doses under strict clinical supervision of its effects. This seems to promise a better prospect of immunizing the patient to the bacillus and its toxin, but it is associated with risk of very acute focal reaction, which might mean waking up such a storm in a joint, that all hope of recovery of movement would be destroyed. As we already use vaccines for the mixed infections, which complicate tuberculous disease of joints, and have found them serviceable, we must face the problem of how best to use tuberculin safely, always remembering that it is a potent therapeutic agent which must be controlled with accuracy, or it may bring us to disaster.



THE USE OF PLASTER OF PARIS IN THE MECHANICAL TREATMENT OF TUBERCULOUS DISEASE OF THE SPINE.

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[With Plates VIII.—XVIII.]

IN the present state of our knowledge of tuberculous disease of the spine, it is recognized that, in the treatment of the lesion, mechanical methods must play a very considerable part. In this article, I propose to indicate the value of plaster of Paris in the treatment of spinal caries, to outline its advantages, the indications for its employment, the technique of its application, and the precautions which should be observed before and during its use.

It is an unfortunate fact that the value of plaster of Paris is so ill-recognized in this country, and that the technique of its employment is so ill-understood. In skilled hands, no more suitable aid to mechanical treatment exists, but its value can only be appreciated by those who are properly trained in its use, and have adequate facilities for its employment. Calot, indeed, whose skill in its application is equalled by few, has said, "When surgeons know how to apply an efficient plaster of Paris support to the vertebral column, the problem of the treatment of Pott's disease will be solved."¹ This remark is hardly an exaggeration.

It may be advantageous here briefly to consider some of the objections which have been raised to its employment. It has been alleged that a plaster jacket is inefficient, and will not adequately immobilize a diseased spine. The efficiency of a spinal support depends, not so much on the material employed, as on the skill with which it is applied.

In the first place, the jacket must be supported from the fixed bony pelvis, and must be moulded most carefully around

the pelvic brim. *This is absolutely essential*, for, unless adequate moulding is obtained, the jacket is useless. With no material is proper moulding more easily obtained than with plaster. A leather jacket, a steel brace, or any such form of splint to the spine is of little value, unless a proper purchase is taken from the pelvis; with these appliances, this is a matter of difficulty. A plaster jacket, on the other hand, can be moulded most effectually, but this is obviously a matter depending entirely upon the skill of the operator.

Next, it must be recognised that to immobilize the spine, the plaster must, in low jackets, be moulded most carefully round the shoulder and girdles, and in particular against the clavicles, and in high jackets, about the occiput, mastoid and, in some cases ("Minerva"), the lower jaw as well. This being done, the plaster jacket will maintain the spine immobile in the attitude of selection, for as long as may be desired.

It has been alleged that a plaster jacket is unsuitable for children, because the pelvis is so little developed that adequate support for the jacket cannot be obtained. Such an objection might be urged with equal force against the use of spinal jackets made of other materials. As a matter of fact, those who raise this objection thereby confess their ignorance of the correct technique of plaster application, because in no class of patients can plaster jackets be employed more suitably and easily. The abdominal muscles of a child offer so little resistance to the adequate moulding of the plaster, that perfect support for the jacket may be obtained from the pelvic brim.

The broad pelvis of the adult makes plaster equally applicable, but in adults its application is more difficult, as the stronger abdominal muscles often offer considerable resistance to the operator during the process of moulding.

The weight of the apparatus has been urged as an objection to its use. Skilfully applied, with proper materials, and with all unnecessary plaster removed after its application, it is lighter than the majority of spinal supports employed, and the patient becomes quite unconscious of its weight.

It has been asserted that the plaster jacket obstructs respiration, and impedes digestion. Jackets made of other

materials may do that, but if a large ventral window be cut out of the plaster jacket, respiration and digestion can in no way be affected, while the strength of the jacket is not interfered with. Sores occurring under the jacket may cause discomfort. These should be avoided if the precautions to be detailed presently are taken.

Plaster jackets have been objected to as insanitary. While I would not recommend them for the ordinary hospital outpatient, yet where the cleanliness of the patients is assured or can be controlled, as in hospital in-patients or with private patients, they are both clean and comfortable, if properly made. For private patients, I have found them particularly useful. Plaster of Paris is porous and the perspiration readily escapes. Indeed, it may almost be said that if the jacket itself be kept clean, the patient is clean also, for when the jacket is taken off no dirt should be found subjacent, but only a layer of dead epithelium, which being removed leaves the skin beneath free from blemish.

The objections alleged are therefore more apparent than real, and the advantages are manifold. An efficient plaster jacket is light, comfortable, porous, clean, strong, rigid, maintains the spine immobile, does not interfere with respiration or digestion, and should so be made that the diseased part of the spine, while being adequately protected, can always be inspected. Moreover, the protection and immobilization is permanent, and by the use of windows, cut in the jacket, abscesses will not develop unknown to the surgeon, whilst if they do (an exceedingly rare complication, if the jacket is applied at the right stage of the disease) they can easily and safely be dealt with by aspiration without the removal of the support.²

The most perfect position of the spine obtainable is maintained immobile for as long as desired. It is the attitude chosen by the surgeon, not left to the mere mechanic; and that selected attitude is maintained with comfort to the patient. There can be no question of deformity arising owing to carelessness or neglect on the part of attendants. The case is entirely in the surgeon's hands. If he is inefficient or his technique imperfect, the patient suffers, but if

PLATE VIII.



Fig. 1.—Method of making plaster. (Part I.)

PLATE IX.

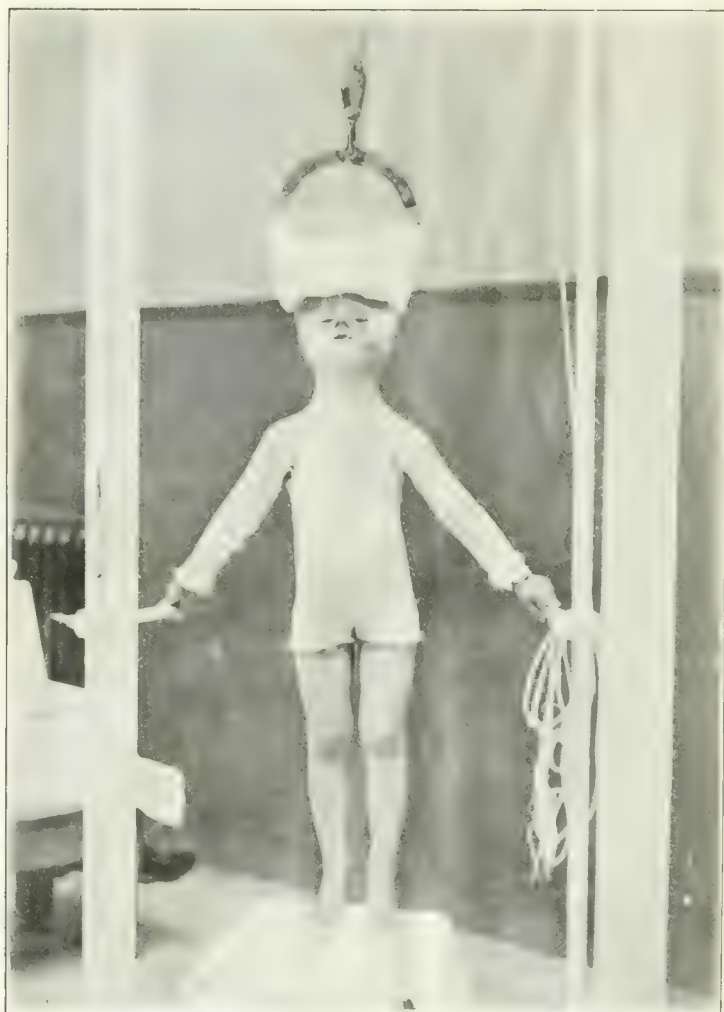


Fig. 1. Patient as held by apparatus for application of the plate for an

he has attained the requisite degree of skill in plaster application, no fresh deformity will arise. The result of treatment will reflect the highest credit on the surgeon's skill, and will afford all concerned the liveliest satisfaction.

A note of warning here : the technique of plaster application must be mastered completely. A plaster jacket cannot be applied by a novice with any likelihood of success. Its application should be practised assiduously for a very long period before it can be undertaken efficiently—otherwise, disappointment is bound to ensue. The greatest judgment must be exercised in the selection of the case, in the period of the disease when the plaster is to be applied, and in the attitude the patient should adopt. For all these things, experience and judgment are necessary. It is misconception of these facts, which has contributed so largely to bring about that disrepute into which the value of plaster in spinal caries has fallen. Plaster technique is conceived to be simple, and is despised accordingly. Plaster application too often is delegated to untrained subordinates. The results have been correspondingly bad, and a most useful means of treatment almost abandoned. Tuberculous hunchbacks are common—tuberculous hunchbacks, given early and adequate mechanical treatment in which plaster should play its part, should be non-existent.

The Indications for the Use of the Plaster Jacket in Spinal Caries.—On this matter, there is naturally difference of opinion, even in those who advocate its use. Decision for its employment may be arrived at after the following considerations:—

If, owing to the condition of the patient, recumbency is desirable, then adequate immobilization may be secured by means other than the employment of the plaster jacket. Therefore, the plaster jacket is not indicated for patients in whom the disease is active, because for these complete rest and immobilization in the recumbent position is of the utmost value. So long as evidence of active disease persists, so long should recumbency be enforced. Spinal rigidity (the manifestation of muscular spasm), pain, excessive temperature, abscess formation, paraplegia, or signs of the involvement of the spinal cord or spinal nerves, the occurrence of new tuberculous

lesions elsewhere, amyloid disease, and often cachexia are all indications for the continuation of recumbent treatment. The plaster jacket, of course, may be used, and in France often is, during recumbency, but equally suitable methods of immobilization are available, and its employment at this stage of the disease is, therefore, unnecessary.

The presence of sinuses does not necessarily contra-indicate the use of plaster. Indeed, some sinuses tend to heal, and in certain cases rapidly, when recumbency is abandoned. But should the sinus be associated with one of the contra-indications already enumerated, or should its situation be such that it interferes with the utility of the plaster apparatus, then plaster should certainly not be employed.

The general condition of the patient, apart from the local condition, must also be borne in mind before deciding to apply the apparatus. It would not be recommended for patients who are weakly and feeble, or in whom complicating diseases would themselves be a certain contra-indication to its employment. Ménard considers that it is contra-indicated in very young children who have not yet acquired cleanly habits,³ but with the excellent nursing now obtainable this is hardly an objection. Corpulency has been mentioned as a contra-indication, because of the difficulty of accurate moulding. The degree of corpulency, which is a bar to its employment, will vary with the skill of the surgeon in applying the plaster.

The size and the site of the lesion must be considered. It may be taken as a good rough rule, that the higher in the spine the lesion, the longer should recumbency be maintained. X-ray photographs are sometimes of service in aiding one's judgment, but great care must always be exercised in arriving at a decision. Commonly, nine months to a year are required, sometimes more, rarely less, of combined recumbency, immobilization and hyper-extension. During this period, no deformity should have occurred, and any deformity which may have existed, and which was not of the nature of a fixed deformity, should have been corrected. Briefly, then, the plaster is to be applied when the active stage of the disease has ended, when there is no evidence of further extension of the lesion and when there is a reasonable prospect of the area affected becoming consolidated and restored if efficiently

PLATE X.



Fig. 2. — Application of application of face etc.

PLATE XI.

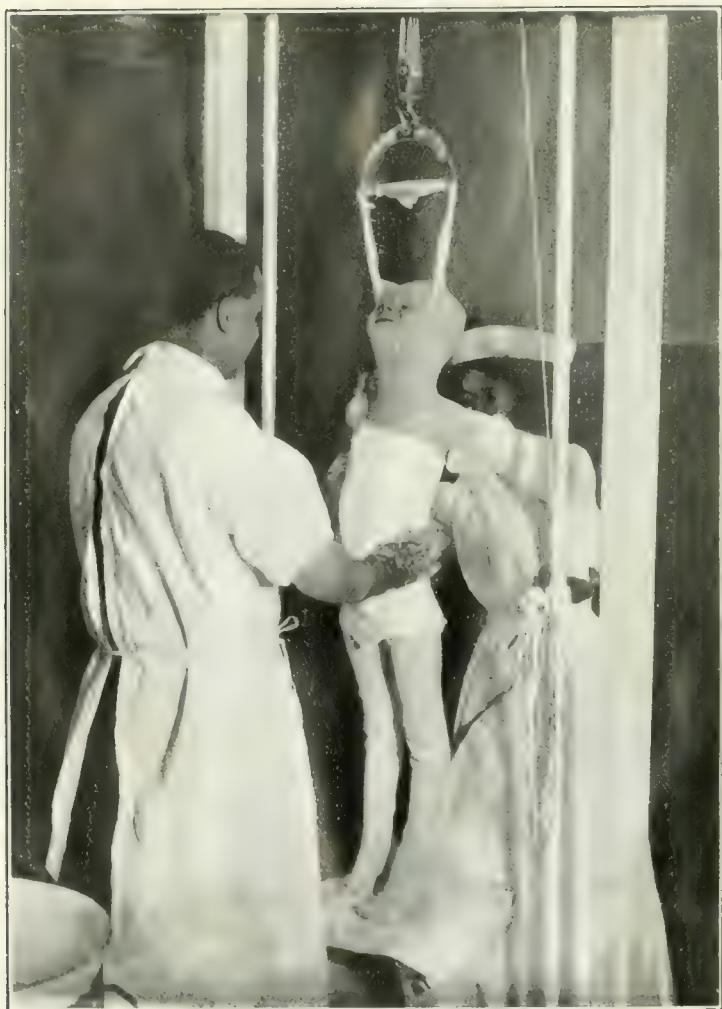


Fig. 4 -Moulding round pelvic area

immobilized.

The Purpose of the Plaster Jacket.—The jacket is to be applied :—

- (1) To maintain the lesion immobile, and allow the injured portion of the spine to become set, firm, properly consolidated, and shut off from the rest of the body.
- (2) To protect the lesion from injury, which might result in further dissemination of the disease.
- (3) To protect as far as possible the lesion from superincumbent pressure.

Except when a jacket is made to transmit the weight of the head direct to the pelvis, it does not in any way relieve the spine of superincumbent weight. It is simply designed relatively to immobilize the spine, and to transmit the weight above the lesion as far as possible through a healthy portion of the vertebral column, and so protect the injured part from undue stress.

Plaster Bandages.—These are usually made by rubbing plaster into special muslin, which is commonly stiffened with dextrine, glue or starch. This method of manufacture is laborious and unsatisfactory ; moreover, the added retarder to the muslin unduly delays the set. When plaster of Paris is being used to a considerable extent, it is infinitely preferable to employ what is known as wide-meshed book muslin, which is exceedingly cheap and very efficient. The size to which the bandage should be made having been decided, it will be found of practical value to fray its edges, which will obviate the annoyance of strips of cotton intermingling with the fingers and interfering with the application. The frayed bandage having been rolled, one end is then placed in a bowl of dry plaster. The left hand is placed down on this strip of muslin, which is then drawn underneath the left hand, and folded over with the fingers of the right hand. In this way, bandages may very rapidly be rolled, and will be found to contain, after a little practice, the right amount of plaster incorporated. The bandage should not be rolled tightly as in that case the water cannot penetrate into the centre, which will remain dry, and inconvenience the operator

when being used. It should be placed into a deep bowl of water sideways, so that the air rapidly escapes from it, and the water permeates it. Cold water is preferable to hot, as the resulting set, though somewhat slower, is stronger.

The patient having been treated recumbently for a sufficiently long period, certain preparations are essential before plaster can safely be applied. In the first place, it must be remembered that the patient has been recumbent, and that, if the plaster is to be applied in the way it can usually be applied most efficiently, that is, with the patient in a vertical position, precautions must be taken to acquire the gradual transference of the patient from the horizontal to the vertical, as any sudden change in attitude will so interfere with the cerebral blood-supply, that a somewhat dangerous and always distressing syncope may result. It is, therefore, my practice to tilt the patient on his board to an increasing degree each day, for a period of about a fortnight. At the end of that time he may assume the vertical position for a considerable period without any discomfort. This tilting may be undertaken conveniently on the spinal stand, which was figured in the *Lancet*.⁴

The skin of the patient should be cleaned, as otherwise skin germs may multiply under the plaster, and an offensive odour be produced. This is particularly important to bear in mind in the treatment of an out-patient. The bowels should have received attention, and have been emptied before plaster is applied, and it is a wise precaution not to allow the patient to have any food likely to cause flatulence during the two days preceding the application of the jacket. In the case of children, it is desirable that the surgeon should have obtained the child's confidence before the application of the jacket, as, to a small child not able to understand the reason for this treatment, suspension may otherwise cause undue and unnecessary distress.

Before the plaster is applied it is recommended that the trunk should be enveloped in a close-fitting vest. This is infinitely to be preferred to the flannel bandages which are commonly used. In addition, it is wise to turn the vest inside out before putting it on the patient, so that even the roughness of the seam is avoided. Over the gastric region,

PLATE XII.



Fig. 1. Application of plaster to the chest: note flexing.

PLATE XIII.



Fig. 1.—*Taking in the shuntiers.*

it is advisable to place a pad of cotton wool, so that if the bowels do become distended before the abdominal window is cut out, no undue pressure will be made on the splanchnic area.

Some surgeons have advised the bony prominences to be thickly padded, but this, in the majority of cases, is quite unnecessary and not to be recommended, because the desired accurate apposition of the plaster is thereby interfered with.

The close fitting vest should be pinned in the perineum, and the patient is now ready to be suspended. If the cervico-dorsal or cervical spine is diseased, it will be necessary for the plaster to extend from the pelvis to the occiput. In these cases, a vest is used with an especially long neck, which is drawn up right over the head, and pinned there; a diagonal window is cut out in the vest just over the nose, which, being stretched, will allow the patient to see, and will not interfere with his breathing.

The Suspension of a Patient.—The patient should be suspended by a bridle *made for each individual case*, because each case should occupy that position which experience has shown will be best for the patient. The bridle is made as follows—The best calico 2-inch bandage, about 4-feet long, is taken, and an ordinary knot tied in it, in such a way that there will be a loop left from the knot. The patient being held up by an assistant, this knot is placed just above the right ear. One piece of the bandage is now passed under the chin, and the other under the occiput, and another knot is tied in a similar position to the first one just above the left ear. One end of the bandage is then passed through the loop which has been left in the first knot, and the two ends of the bandage are tied by an ordinary reef knot.

The patient may then be suspended from the chin and the occiput on the cross piece of the gallows. The actual position of the knots will vary in different cases and it will be noticed that the more anterior the knot the more hyper-extended the head will be; the more posterior the knot, the more flexed the head. Any existing lordosis should, as far as possible, be corrected. Usually, it is desirable for the patient to be extended only sufficiently for the heels to be off the ground with the toes resting on the floor. His back may be urged somewhat forward, and his hands, while not resting on,

should hold adjustable cross-pieces at the sides of the gallows. This will increase the patient's comfort while ensuring the maintenance of the desired attitude.

Application of the Plaster.—I shall describe the application of a high jacket, as used for cervical or cervico-dorsal caries. Such a jacket is called by the French a "Minerva." If the disease is below the fourth dorsal vertebra a jacket, extending to the neck is sufficient and very much easier to apply. A high jacket should never be applied, until considerable proficiency has been obtained.

The patient being suspended in the manner indicated, the surgeon stands in front of the patient and his assistant behind, and the bandage is applied from below upwards. Bandages 6 inches in width are recommended. The bandage, which has been placed in the water before the suspension of the patient, is now removed, and the excess of moisture in it squeezed out. It should be squeezed with both hands—one hand being over each end of the roll, so that while the water is being squeezed out, the plaster remains *in situ*. The free end of the bandage is then given to the assistant, and applied to the right hand side of the patient just below the right iliac crest. The bandage is then unwound, and passed round and round the patient, but at least once during each circuit of the patient it should be pleated as shown in the illustration (Fig. 5).

To make this pleat the onward course of the bandage is delayed, and the bandage is passed backwards along this course for about an inch, and then forwards again; it will be found by adopting this simple expedient that the bandage can be carried easily in any desired direction. Further, the break thus afforded in the continuity of the bandage allows a certain amount of give before setting, which permits the abdomen or the chest to expand to its usual capacity, and thus undue tension is avoided. In addition, this simple expedient allows the surgeon rapidly and easily to reinforce the jacket, in any particular part where he thinks additional strength is desirable. No reverse should ever be made in the plaster bandage.

The direction the bandage should take will depend on the way in which the pleat is made, and it will be found that the bandage will of itself travel smoothly and evenly over the patient without rucks or crinkles, and can thus be

PLATE XIV.



Fig. 7--Applying plaster to the head

PLATE XV.



Fig. 8.—“*Minerva*” completed.

applied evenly and quickly. After each turn, the bandage should be rubbed lightly in the direction it has taken, to secure its incorporation with subjacent material. Usually two, or sometimes three, 6-inch bandages, 4 yards long, are all that is necessary to encircle a patient's trunk efficiently. By the time these three bandages have been applied, the first bandage is set sufficiently to enable the moulding to the pelvic brim to be undertaken.

The greatest possible stress is laid on this procedure, for it is from the fixed pelvic base that support for the jacket must be obtained. A jacket, which is not moulded around the pelvic brim, is useless and inefficient. In the moulding, care should be taken that no pressure is made on the bony pelvis, but on the soft abdominal wall above this bony pelvis. The shoulders, well pressed backwards, are incorporated by simply passing the bandage backwards and forwards from chest to back, until a sufficient number of turns have been made to give the support required. These shoulder bandages are next held in place by a bandage, starting from below the axilla and encircling the trunk twice in this position, and the jacket is well moulded on to the clavicles. The bandage can then be continued on to the neck.

The Neck.—The neck of the patient is encased in plaster by passing the bandage several times around it, and pleating it at least twice in each circuit of the neck. This bandage must pass from the neck, around the head, under the chin, and under the occiput; it must, in fact, encase the head completely except the face, which alone is not encircled in the plaster. It should specially be strengthened posteriorly. The jacket thus applied will hold the patient firmly and absolutely, and the lesion will remain immobile. In taking in the head, the surgeon must most carefully mould the plaster under the chin, under both mastoid processes, and around the occiput.

The jacket completed, windows are marked before the patient is taken down from the gallows. It will be seen that a large ventral window will efficiently prevent any interference with respiration and digestion, and this window should be cut out on the second day after the plaster has been applied, providing the patient's condition has not made it necessary to make it earlier. The plaster involving the head

may be cut away below each ear, so that it will only press up against the occiput, the mastoids, and the chin. In its lower part, it may be cut away so that it will rest on the pelvis, but allow free flexion of both thighs. If any angular curvature exists, a window should be cut out over the curvature, so that this part of the spine may be kept under observation.

Precautions to be observed during the Application of the Plaster and until the Windows are cut out.—Care should be taken that the patient does not faint. Such a catastrophe is avoided, if the precaution of gradually tilting the patient, already alluded to, is observed. Apart from faintness and occasional irregularity of the pulse, I have never seen any complication occur during the application of the jacket, but until I adopted the precaution of tilting the patient, I found that faintness was common on suspension. At the first trial of putting on plaster, a low jacket should only be attempted, because it is desirable that the jacket should be applied as rapidly as possible for the patient's comfort, and the difficulties in putting on a high jacket are so considerable, that such an apparatus should never be attempted, until considerable experience has been obtained.

After the patient is taken down, the jacket should be left untouched for two days before it is cut out, so that the set shall really be firm, and all the surplus water in the jacket sweated out. Sometimes, it is found that the patient's pulse during this period is a little irregular, but that is a rare occurrence, and has never been sufficient to cause any anxiety. One common complication, which will occur unless the precautions already alluded to have been taken, is persistent vomiting. This, I believe, is always caused by undue distension of the abdomen, and can be avoided by dieting the patient before the application of the jacket, and until windows are cut out. It can be relieved immediately by cutting out extensive windows, but the premature cutting out of the ventral window is undesirable, if a sufficiently strong apparatus is to be obtained. Accompanying this sickness is excessive pain, if there is undue distension in the tight jacket; this is also relieved by cutting out the window, but it will not occur, if attention has been given to dieting and the bowels.

Two days having elapsed after the application of the

PLATE XVI.



Fig. 9. "Minerva" completed on skeleton to illustrate bony points about which jacket should be moulded.

PLATE XVII.



Fig. 13.—76. "Fillet" applied to skeleton to show the points at which the moulding should take place.

plaster, the apparatus is now ready to be finished and the windows are cut. An ordinary penknife is quite sufficient for the purpose, and after a little practice it will be found that the windows can be made expeditiously. It facilitates the cutting out of these windows, if the knife is constantly dipped in water. Acetic or other weak acids have been recommended for application to the plaster previous to the windows being cut, but I do not recommend the employment of these, as they render the jacket friable, and are quite unnecessary after a little skill has been obtained. Good shears are sometimes of assistance, but the ordinary shears with long blades are useless. Short blades and powerful handles giving sufficient leverage are recommended.

The plaster having been cut where indicated, the vest is turned back over the plaster, and fastened down to it by the application of plaster-cream, which is spread evenly all over the jacket until a smoothly polished surface is obtained. The plaster-cream is lightly rubbed with wet hands, until a high polish is obtained. Plaster-cream can best be made by adding about 3 parts of water to 5 parts of plaster. The result of its employment will be highly satisfactory, as a beautiful finish is obtained, and the life of the plaster is prolonged. The plaster may be kept nice by being scraped a little, perhaps once monthly, and again polished, and in this way, with reasonably clean patients, plaster jackets can be kept on almost indefinitely.

Sores under the Plaster.—If the plaster has been applied very carefully sores are not likely to occur, but their onset can even be detected before they actually form, because skin germs multiply where sores are about to occur, and give off a peculiarly unpleasant odour, suggestive of the smell noticed from the skin of people of uncleanly habits. If then, as soon as this odour is noticed, a window is cut, the formation of a sore can be prevented. A curious point about these sores is that they are usually painless, and quite often it will be found that the patient is unaware of their existence, and a considerable amount of sloughing may take place before they are detected. Their formation, however, is very rare, and should not occur if the patient is efficiently nursed.

If the disease is in the dorso-lumbar or lumbar region, it will be found that the plaster jacket applied to the patient

over-extended in the horizontal position will be efficient, but I certainly do not think it is easier to apply a jacket with the patient horizontal than with the patient suspended, and only in low caries is such a jacket of any use. The application of a jacket with a patient horizontal will, therefore, not be described in this paper.

Calot has suggested a means of correcting angular curvature while the patient is in a plaster jacket, but space does not permit its description here.

The Fillet.—The high jacket ("Minerva"), the application of which I have already described, is commonly used on the Continent. While very efficient, there are some objections to its use. It does not ensure complete immobility, because of the necessity of mastication, and the difficulty of mastication is greatly increased owing to the necessity of raising the head instead of depressing the jaw while eating. In young children it may, to a certain extent, deform the jaw, and in male adults the growth of the beard is an intolerable nuisance.

To obviate these drawbacks, I have devised another form of high jacket, which has all the advantages of the "Minerva," none of the disadvantages, secures better immobilization, and is, therefore, more efficient. To this jacket has been given the name "The Fillet" (see Figs. 10 and 11), owing to the fact that the head is maintained immobile by retaining a plaster band in the frontal region. Patients with such an apparatus can eat and shave with perfect comfort. It need hardly be emphasized again that this jacket must be moulded most carefully and thoroughly under the occiput and mastoid.

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¹ Calot: "Comment il faut faire l'appareil de Mal de Pott," *Semaine Médicale*, January 4, 1905.

² Calvé and Gauvain: "The Treatment of Tuberculous Abscesses of bony Origin by Conservative Methods," *Lancet*, March 5, 1910.

³ Menard: *Etude Pratique sur le Mal de Pott*. Paris: Masson & Cie., 1900.

⁴ Gauvain: "The Mechanical Treatment of Spinal Caries—Splints and Hyperextension," *Lancet*, March 4, 1911.



PLATE XVIII.



Fig. 11.—The "Fillet" applied to a patient with cervico-dorsal curves. This patient was admitted with complete paraplegia and incontinence of urine. Six months later she had recovered the use of her legs, was no longer incontinent, and a plaster jacket "Fillet" had been applied. In the illustration shown, she is not yet able to sit up without some assistance. Note the ample space allowed for respiration and digestion, and the freedom of the shoulder girdle.

THE TRYPSIN TREATMENT OF SURGICAL TUBERCULOSIS.

By DR. WILHELM BAETZNER.

First University Clinic, Berlin; Director, Professor Bier.

[With Plates XIX.-XXIV.]

THE conservative treatment of surgical tuberculosis is gaining ground fast, and surgeons of the highest standing and experience, like Bier, Garré, Calot, and many others, daily enlarge its scope. A recent article of Calot very characteristically closes as follows:—"To summarize an experience of over 25 years—we can now justify for local tuberculosis the best possible prognosis, given the following conditions and treatment: life in the open air; for the part affected, rest and immovability with comfortable, well-fitting orthopædic appliances; and for active treatment, the fullest renunciation of the knife, except for puncturing abscesses, and for alterative injections (injections modificatrices)."

Of the many substances used for such injections, I have obtained comparatively the best results with injections of trypsin. As the technique of the injection and the choice of the suitable material present some difficulties, I have paid particular attention to these two points.

In spite of the excellent results obtained with the trypsin treatment, I should prefer, in submitting this article for professional consideration and judgment, to see it treated rather as an incentive to further investigations than as a presentation of a definitely and finally shaped therapeutic procedure. At the same time, it would seem a pity to withhold from the patient the benefits of a treatment, so harmless, so effective, so easily applicable, and so satisfactory, even in its cosmetic results.

In the phase into which the conservative treatment of tuberculosis is at present entering, we can clearly distinguish two notes: the physiological and the bio-chemical.

As Muller justly remarks, it was Bier who redirected the therapy of the suppurative processes to physiological ways,

his methods tending to an accentuation of the protective forces naturally present in the organism, and their concentration upon the parts affected. Other adherents of the conservative treatment show a stronger leaning towards more chemical conceptions, going back as far as Listerian influences. Müller and Jochmann, in conjunction with others (comp. ref. 2-8), have succeeded in combining both these methods, and giving this revival a more definitely experimental basis. They found that "hot" pus containing cocci has a powerful proteolytic action. This distinguishes "hot" from "cold" tuberculous pus, which contains principally detritus and lymphocytes, and is, in consequence, entirely devoid of any proteolytic action.

These observations suggested the anti-ferment treatment of "hot" pus, and on the same grounds, in November, 1908, I was encouraged to try the effect of proteolytic ferments upon tuberculous suppurations, with the idea that these ferments would resolve the suppurations, and that their absorption would attract to the seat of injection the curative forces of the organism. This conception had further support in the researches of Heile, who found that "the iodoform-glycerine treatment of tuberculous processes only acts by means of the chemiotaxic action upon the polynuclear leucocytes which accumulate at the site of injection, and the proteolytic ferment of which resolves the pus, rendering it absorbable by the surrounding tissue."

PHARMACOGNOSTIC NOTES ON TRYPSIN.

My first clinical attempts gave good results at once, but at the same time showed the great difficulties attending the choice of suitable material. Beard had originated a treatment of cancer by injections of trypsin and amylopsin, and Fermi and Pinkus had proved the harmlessness of trypsin injections. Following these indications I was able to convince myself, by experiments upon animals and, subsequently, upon myself, that the subcutaneous injections of *freshly prepared trypsin, in the quantities now under consideration, were practically innocuous*. It appeared that the toxicity of ferment-preparations was largely due to the products of decomposition arising from bacterial action. It proved, however, a matter of great difficulty, in an ordinary laboratory, to obtain solutions at once sterile active,

and sufficiently stable, from the fresh gland or the dry commercial preparations.

The publications of Pinkus, who had used trypsin for injections in cancer, directed my attention, after a year's trials, to a preparation of Fairchild Brothers and Foster, New York; and this was the only one which proved satisfactory in every way. The injections are sold in glass ampoules, holding 1 c.c. The trypsin is dissolved in 60 per cent. of glycerine. I have kept these ampoules in my room without any precautions for almost two years, and even after this time the ferment-strength remained unimpaired. They are also easily the first, for the strength of their ferment action, among the preparations known to me. The following table shows the differences that exist :—

LIST OF TESTS, MADE 5TH MARCH, 1911.

A.	B.	C.
I. Injectio trypsin (Fairchild), said to be prepared in 1906, and kept without any special precautions at room temperature, and in the possession of the author since October 1909 -		1 : 4000
II. Injectio trypsin (Fairchild), kept in the author's possession since October 1909 -	- - - - -	1 : 4000
III. Injections in ampoules by Freund and Redlich, dated 5th January, 1911 -		1 : 32
IV. 1 per cent. solution prepared from trypsin (Kahlbaum), about 1½ years' old -	- - - - -	1 : 32
V. Trypsin solution (Merck) in ampoules, prepared by special request in January 1909 -	- - - - -	1 : 64

Under column C. the titre is given, that is, the dilution at which a given solution gives just a faint mark on the serum plate, and below which it would fail to do so.

Müller's trypsin test is made by noting by what dilution no visible depression is produced upon a Löffler plate, incubated at 55-60° C. The test is made by diluting the given trypsin solution, with one containing about 20 per cent. glycerine and 0·8 saline solution, upon a porcelain plate with depressions. The Löffler plate is then subdivided on the reverse

side with ink or pencil into from 9 to 16 squares, numbered to correspond to the depressions of the porcelain plate, and the plate is placed upon white paper to allow the divisions to shine through; then, with a platinum loop a drop of each of the dilutions is placed upon the plate.

The plates are then placed in an incubator and kept for 12 hours at from 55 to 60°. This high temperature is used to hinder the development of bacteria. The dilution is then marked at which the solution gives the last depression. In satisfactory preparations, this should be about 1 : 1000. This is the standard maintained now by the Fairchild preparation.

CLINICAL OBSERVATIONS ON THE ACTION OF TRYPSIN INJECTIONS.

Having satisfied myself that trypsin injections, especially in the form of the *Injectio Trypsini* (Fairchild), produced absolutely no ill-effects, even if injected in doses up to 3 c.c. at a time, I decided to use this one preparation throughout. I do not desire here to enter into a discussion of the further work, done by myself and others, on the action of large doses of trypsin on the animal organism, as it is not related to the subject, and has been dealt with elsewhere. (For full references, see 2, 13, 19, 22, 14.)

I must first draw attention to the fact that trypsin diffuses very slowly from the tissue into which it is injected. Nevertheless, its action upon normal tissue on injection is practically nil. The actual pain from an injection of trypsin, in a dilution of 1 : 10, is quite insignificant.

In no case did I notice any effect of trypsin injections upon the general state of the healthy organism. My observations on healthy, as well as upon tuberculous, cases never showed any action upon the kidneys; in no case was any sugar or albumen noticed in the urine.

The general clinical picture is quite different, when treating the subjects of superficial tuberculous affections. The introduction of trypsin into tuberculous tissue is followed, generally a few minutes later, by a slight smarting pain, which only in a few cases reaches any intensity, but is always quite bearable. Sometimes, a slight rise of the temperature will be noted, which also passes off very soon. The local reaction is, as in the healthy, very often quite insignificant. Sometimes, the skin appears slightly flushed for some time after injection, and other signs of local irritative inflammation are noticed, such as swelling, local heat, and a slight sensitiveness to touch.

In very exceptional cases, symptoms have been observed, which appear quite serious when seen for the first time, such as, violent inflammatory reactions bearing all the characteristics of acute inflammatory phlegmon; intense smarting pains a few hours after the injection; vivid flushing, considerable heat, and an increasing cushion-like swelling locally accompanied by rigor and high temperature. All these symptoms disappear, however, spontaneously within 24 to 28 hours, and the swelling has gone in from 4 to 6 days later.*

Of the greatest interest and significance are the changes observed in the *seat of the infection*.

They are most typical in tuberculous abscesses of all kinds. The colour and consistency of the pus change gradually, and the formed elements disappear; the fluid first obtained, from such an abscess at this stage, is brownish, and of syrupy consistency, but later it becomes quite thin and serous, and very often contains a quantity of blood which makes it look like expressed meat-juice. The changes are noticed mainly towards the inner part; from the margins a thick wall of granulations will soon be found to extend inwards, which fills up the cavity, draws the walls together, and gradually forms a scar. Very often the walls of the abscess will be found considerably thickened. In this way, many abscesses under my observation and treatment, arising either from the lymphatics or the subcutaneous tissue, as well as those deeply seated, were completely absorbed with a minimal tissue loss, that is, with the best cosmetic result imaginable.

Following up these processes under the microscope, I found that the appearance of the pus altered even after the very first injection. If a sample of pus was taken from a tuberculous abscess after the first or second injection of trypsin, I found, among the typical detritus and scanty lymphocytes, numerous red blood-corpuscles and quite an appreciable quantity of polynuclear leucocytes, especially of eosinophile cells. Other cellular elements were also found to have increased, while the lymphocytes had decreased considerably. *This shows that after a few injections of trypsin, the blood has gained access to formations previously torpid.* After a few more injections, formed elements began to appear, and then the secretion was absorbed remarkably quickly; healthy granulations sprang up, later the blood vessels surrounding the former abscess began to get smaller, and with their obliteration the granulations were turned into connective tissue, and cicatrization was complete.

* As experience accumulated, I found that these violent reactions were never observed when injecting into healthy tissue or in the presence of open lesions, but that they were met with almost exclusively in cases in which large accumulations of tuberculous pus, such as are found in synovial hygromata and other closed tuberculous abscesses, were suddenly submitted to the action of trypsin. We must, therefore, conclude that they were due to a sudden activation of hitherto inert masses, and that the consequent reaction induced extreme tension in the surrounding tissue.

This histological investigation, completing the picture, was carried out on abscesses, after one or more injections, while in their different phases on the way to a complete cure.

Thus, for example, a tuberculous abscess of the mamma, the size of a hen's egg, which had shrunk under the influence of a few injections of trypsin to the size of a walnut, presented the following appearance:—Among the proliferated older and newer connective tissue were numerous cells, with an abundant development of blood vessels, in part an epithelial proliferation, partly in the form of follicles, and partly as irregular cones between the collagen connective fibres carrying numerous mitotic figures. All round the epithelial and follicular proliferations a broad wall of eosinophile cells was found (2 and 24).

All this goes far to prove the contention I upheld in my first publication: "Under the influence of the ferment-injection, a vigorous reaction takes place in the tuberculous focus; an ensuing hyperæmia, cellular infiltrations, and proliferations, lead to a transformation of the substance and the structure of the pathological tissue, and to necrosis of the fungoid masses *without impairing in any way the vitality of the healthy parts.*"

Here, again, hyperæmia forms the central, or rather the turning, point in this *restitutio ad integrum*. It is, indeed, as if, at the moment when the blood appears within the inactive tissues, we had broken through a vicious circle; and recovery may safely be said to start when the first blood corpuscles appear in the pus. Whatever rôle is played in this by the trypsin, to clinicians this may suffice as a fact, and form a sufficient interpretation of all the other changes. It will, at any rate, appear sufficient to account for the one process which attracts special attention, metaplasia, a reappearance of healthy tissue in exactly the place where, previous to injection, it was quite unsound. What happens is not only a proliferation of sound tissue into morbid, but it looks as if a part of the diseased cells were recovering and taking up their normal functions. Even in affected bones, it is not always that the diseased part is thrown off, and then replaced by a new growth from the sound part, but very often it simply "gets well" under treatment.

Obviously, there is no necessity to look for a direct antibacillary action of the trypsin—we see, on the contrary, that such an action is not found outside the organism. But it is very significant that, concomitantly with this re-birth and

re-formation of the tissues, induced by the hyperæmia, the bacilli disappear.

CLINICAL EXAMPLES.

Often after a few trypsin injections, not only the masses of pus resolve and become amenable to absorption, but the *very focus of tuberculous inflammation*, from which the suppuration arises, undergoes a gradual change which starts recovery. After each injection the nodular infiltrations soften, disintegrate, throw off all kinds of cellular detritus, and finally liquefy and undergo absorption, while from all sides healthy tissue proliferates abundantly. This powerful stimulation of the production of florid granulating tissue is the most typical reaction by which the diseased part replies to the action of trypsin, whatever this may be. All the tissues, over which the influence of the trypsin extends, show at once a marked hyperæmia, numerous blood points are seen in the ulcers, and every insertion of the needle draws blood freely; it is, we repeat, this local hyperæmia from which all these regenerative changes proceed.

Case.—H. W., aged 25, November 10; over the right trochanter, tuberculous abscess the size of a child's head. Aspiration with a trochar yielded about 100 c.c. of a viscid crumbly pus, which, on microscopical examination showed mainly detritus and lymphocytes. Injection of 1 c.c. trypsin (Fairchild). After this first injection, rise of temperature. 14th, 18th, 22nd—1 c.c. trypsin injected; 24th, the aspiration produced 25 c.c. of a *sanguineous serous liquid*. Up to December 10, further six injections administered, the abscess being gradually displaced by diffuse cicatrizing tissue. December 15, cure completed.

Under the influence of trypsin injections, *suppurating sinuses* proceeding from tissue or bone, soon get much smaller: the secretion loses its purulent character, becomes after a few injections quite serous, and later disappears completely; whilst the pale, dirty granulations at the orifice turn fresh-coloured and bleed easily; the sinus loses its depth, and its walls soon show an inclination to cohere.

Br. Sch., 12 years, had been treated for suppurative coxitis for several years. Two sinuses, secreting pus profusely, on the front and outer part of the hip, but not leading to the joint. April 5, 1 c.c. trypsin injected around and into the walls of the sinuses. Even after this first injection, the secretion diminished considerably, became gradually thinner and more serous. April 8, the injection as above repeated. April 10, only a very insignificant secretion. April 15, another injection. May 1, both sinuses

closed. Seen $1\frac{1}{2}$ years later, the sinuses have remained closed, no sign of relapse.

Quite analogous are the changes noticed in *superficial tuberculous ulcers*, whether primary or derived from deeper foci. Under the influence of injections, they clear remarkably quickly; in place of flabby overgrowth, pink granulations appear, the base of the ulcer secretes less and less, dries, and grows up level with the surface of the skin, while the growing epithelium more and more closes in upon the patch, and finally covers it entirely. In most cases, not even a scar is left to indicate the site of the ugly ulcer.

Boy, Br., 7 years old. Operated on for synovial hygroma situated upon the inner knuckles. Primary union broke down ten days afterwards, and in its place a dirty ulcer the size of a crown developed, showing absolutely no tendency to healing. Conservative treatment with ointments, moist compresses, iodoform-glycerin, and cauterizing, had no effect whatever. January 22, an injection of 1 c.c. trypsin. Up to February 20, ten injections around the ulcer and into its base. Even after the first injection, the granulations looked much less sluggish and bled easily from the margin, and the epithelium encroached upon the ulcer. February 25, smooth clear scar.

Of particular interest are the *synovial hygromata*, because in these the influence of trypsin can be demonstrated without the intervention of any conflicting agent. Typical granulating hygromata of the common flexor sheaths of the palm, as well as of the extensors, revealing "snowball-crunching," improved, and the tendinous functions, which had been lost before treatment, were restored in almost every case. Even after the first injection, the crunching disappeared, the functions of the tendons improved, and were even fully restored, whilst the tumour was absorbed, and in the worst case, as a sole residuum, a thick fibrous infiltration of the walls remained.

C. G., 20 years of age. Typical metacarpal tuberculous hygroma; the function of both hands almost entirely suspended. When the hands closed, the finger tips were still removed 4-5 c.m. from the palm. Between May 16 and October 2, 7 injections were administered into the right, and 5 into the left hand; all of 1 c.c. of trypsin (Fairchild) each. Full cure with absolute restitution of function. The only trace remaining for some time was in the form of scar-like indurated threads. When seen one year afterwards, no trace of the affection could be recognized locally, and the functions were fully re-established, although the patient had been engaged in type-writing and other manual work all the time.

Even diseased bone joins in this restorative change, and does not, as Brünig would have it, form an obstacle

PLATE XIX.



Fig. 1. Case I. (figs. 211) previous to treatment. Long, tongue (ed.) Three
 and a half inches down to the

PLATE XX.

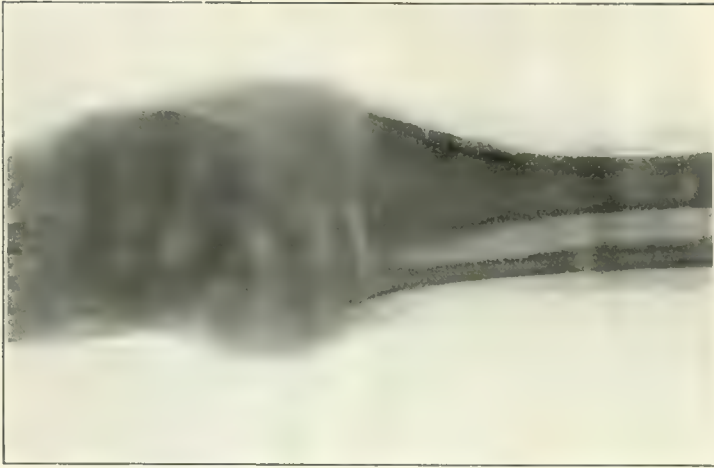


Fig. 2. S. 12111. I. Case I. picture to treatment page 211. Extreme atrophy of the alveolar process, atrophy of the alveolar bone lateral to the alveolar ridge.

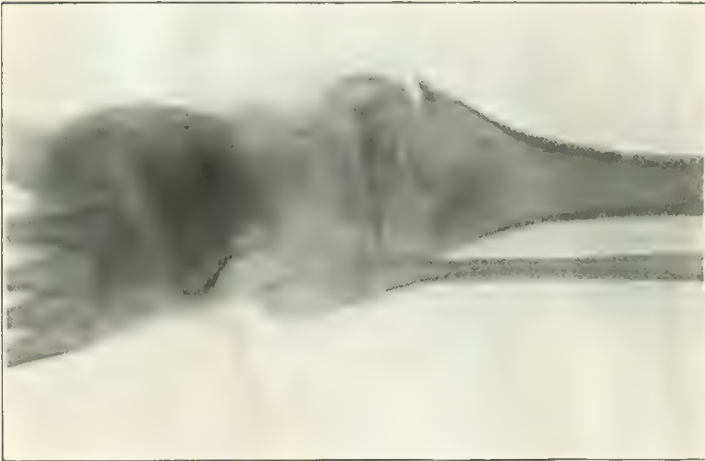


Fig. 3. S. 12111. I. Case I. picture to treatment page 211.

to perfect cure. Quite the contrary, all the Röntgen pictures prove that bones, profoundly destroyed in the course of disease, may retain their regenerative powers, and re-assume, under the influence of trypsin injections, their original structure and contour. Although in all the cases observed, it was the *growing* bones of children which responded so favourably to the trypsin treatment, this does not detract from the value of the fact that bones, profoundly altered and destroyed in the progress of the tuberculous changes, finally become quite sound and normal, frequently even without sequestration.

The spontaneous pains and the sensitiveness to touch disappear entirely, passive movements are tolerated without any sensation of pain, and even the active movements later, and, in the better cases, all the functions of the limb are restored. The progress of this treatment is best learned by a closer study of the following typical cases:—

1. G. H., little girl, four years old. Mother died of phthisis. The joint of the left foot swollen, had been so for two years. Had been treated by various methods since the beginning of 1908. Everything else having failed to produce an improvement, trypsin treatment was started June 17, 1908. Condition at that date: Large fungus of the joint of the right foot (Fig. 1). Above the joint externally, and below internally, three sinuses with large extensive ulcerations. The sinuses and ulcerations were full of pus. The sound reached roughened bone. Foot extended downwards, active and passive movements impossible, the whole part being very sensitive. The Röntgen photo. (Fig. 2) showed extensive destruction of the tibial epiphysis, extensive atrophy of the tarsal bones, and lateral disintegration of the astragalus.

Treatment.—From April 18, 1908, every 2 or 3 days, from 1 to 2 c.c. of a 1 per cent. trypsin solution. Up to March 1909, 50 injections. Patient wearing removable plaster bandage. The swelling went down even after the first injections, the soft fungoid parts began to harden, especially at the points of injection. The secretion of the sinuses decreased and changed very much in colour and consistency—became thinner, and, later on, tinged with fresh blood. The ulcerations began to look fresher and to be covered over with epithelium. March 1909 to May 1909, treatment discontinued. In May, 1909, the child was practically cured, except for two superficial sinuses, which disappeared after ten trypsin injections (Fairchild). In March, 1910, the child was definitely cured.

December 4, 1911, the girl continues in excellent condition. The tendinous function restored, gait normal. (Fig. 3.)

2. M., girl, 10 years old, of quite a healthy family, had in August, 1908, a kick on the right foot from a horse. Eight days later, a swelling formed, which was dressed with different ointments without effect. From a week later until November 28, the foot was kept in plaster. On December 8,

1908, treatment was started.

Condition.—The right ankle was very much swollen and the capsule very much distended. The whole part showed distinct fluctuation. On the outer side of the ankle, there was a swelling the size of a goose's egg, over which the skin appeared as thin as paper and on the point of giving way. The foot was bent downwards, and both active and passive movements were impossible because of intolerable pains. A skiagraph showed advanced atrophy, especially of the metatarsal bones, whose outlines were quite indistinguishable. Some pus was drawn off and injected into a guinea-pig, which *showed extensive tuberculosis*.

After ten injections given between December 8, 1909 and January 25, 1910, the ulcer looked clean, sound epithelium growing from the margin; the secretion was serous, and contained blood, but *no tubercle bacilli*.

Until March, 1909, seven injections more. Seen January 14, 1910, the joint perfectly healed. Skiagram showed outline of the bones to be much improved, though atrophy still present.

By May 3, 1910, the patient could walk with a stick all the way to school, about $1\frac{1}{2}$ kilometres; since October, walked without any assistance. Well developed when seen January 24, 1911. Weight, January, 1909, 57 lbs.; January, 1911 81 lbs. No relapse.

3. J. K., girl, 9 years old. Mother died of tuberculosis. Since June 1908, severe swelling of the left ankle, rendering limb quite useless. Treatment in hospital. In December, suddenly got worse. Abscesses opened, and plaster applied. Up to April, 1909, orthopædic treatment, without any improvement.

Condition.—April 5, 1909. Several sinuses, leading to bone; suppurative tuberculosis of the ankle. Both sinuses and ulcers secreting thick pus, every touch excessively painful, active and passive movements impossible. (Fig. 4.)

Röntgen photo. (Fig. 5) showed advanced general atrophy and almost entire obliteration of the bones of foot and the shin; extensive destruction of calcaneum and astragalus, and of the epiphysis of tibia and fibula; astragalus pressed up into the epiphysis of the tibia.

The child looked very ill; weight only $48\frac{1}{2}$ lbs. April to September 3, 1909, five trypsin injections a month, altogether 24 injections. Removable plaster-splint applied.

After further ten injections between January, 1910, to July, 1910, nearly complete cure. When seen in April 10, 1911, child completely cured. Seen again December 1911, child developing very well indeed. Uses both feet equally well, the functions completely restored. No sign of relapse. (Fig. 6.)

4. C. H., 11 years of age. Very bad case of sinus from suppurating fungus pedis. Bones badly implicated. (Fig. 7.) Between April 26, 1909, and March 15, 1911, 40 injections of one ampoule each of *Injectio Trypsini* (Fairchild). In December, 1911, quite cured. When seen last in August, 1912, no relapse. (Fig. 8. and 9.)

5. D. M., 32 years old. Diagnosis: suppurative tuberculosis of left wrist with large abscess and sinuses. Treatment with injections of trypsin (Fairchild) begun March 2, 1909, altogether 32 injections. In spite of a very

PLATE XXI.



Fig. 4 - Case III, (p. 212) before treatment - (p. 213) after treatment - the ulcer, scab, mass, healing - (p. 214)

PLATE XXII.



Fig. 7. — Diagram of Case III, previous to treatment (only, Fig. 4 and page 12).
Extensive destruction of calcaneus and astragalus and of the epiphysis of tibia
and fibula; astragalus pressed up into the epiphysis of the tibia.

advanced phthisis in May 1910, the bone tuberculosis fairly satisfactory. In February 1911 death from hæmorrhage.

I have chosen these cases from abundant material, because they were of the most obstinate type; because, in my experience, they could not have improved spontaneously; because the trypsin appeared distinctly to be the only definite curative agent; because they are the most instructive; and because they were among the first treated with trypsin, and therefore they could not have at the outset all the benefits of my later experiences in technique and the selection of the preparation. *They have remained up to the present without relapse.*

With improved methods and better preparations, the treatment is much shorter and more effective, especially if combined with the accepted orthopædic and climatic methods of treatment.

PHARMACODYNAMICS OF THE TRYPSIN TREATMENT.

All the observations point quite definitely to the fact that, in diseased tuberculous tissue the influence of trypsin, given by injection, calls forth a two-fold reaction: the destruction and absorption of those cells too far affected for recovery; and, on the other hand, the formation of new and normal cells, with a metaplastic recovery of some of the diseased cells. Both these reactions are induced by the hyperæmia, which seems to be the direct response within the tuberculous areas to the trypsin injections.

Having thus substantiated the clinical connection existing between the injections of trypsin, and the changes produced by these in all types of surgical tuberculosis, further confirmed by the microscopical appearances of the corresponding stages; we have to ask, further, what is the mechanism of these reactions? In the introduction, I stated that all my clinical experiments were based upon the supposition that, by bringing trypsin into contact with tuberculous tissue, we should simply resolve the pus and altered tissue, and thus bring about absorption. Whether events can establish this, perhaps, somewhat too plausible explanation, it is difficult to state at the present stage of our investigations. Trypsin does not act upon the bearer of the infection, the tubercle bacillus. I did not observe any action of trypsin upon the growth of tubercle bacilli with our very powerful and pure preparations. I investigated further whether the injection of trypsin, previous to or after infection, in small or large doses would in any way affect the resistance of guinea-pigs to human, or to bovine, tuberculosis, but could not prove a protective action in any single instance.

The most important fact telling against a direct action, or, let me say, against the acceptance of the direct action alone, is the remote effect of the trypsin injection. When injected into the circulation of rabbits, even in large quantities sufficient to give the blood a titration of 1:60, *one minute after injection it cannot be discovered*; yet in those cases in which I injected, *remotely* from the seat of the disease, the action was, though not so prompt,

yet quite satisfactory. There is, besides, the whole literature on injections of trypsin in cancer, introduced by Beard, which are never done locally, but in which reactions are obtained. There are, also, Lewis's reports on the favourable results obtained in pulmonary tuberculosis, which, unfortunately, have remained unrepeatable. I would, therefore, advise injection, both locally and remotely, into the back, the arm, etc.

The general effects, however, are too striking to permit of any doubt; the improvement in the general condition, bodily and mental, of the patient, accompanying the unusual improvement of the appetite, will be observed whenever trypsin is injected. "The children become downright gluttonous after the first injection," is the constant report of the parents, the injections proving particularly active in tuberculous children. The first to observe and to use injections of trypsin in pulmonary tuberculosis, H. E. Lewis, whose publication of his results in 38 cases was unknown to me until long after I had started my treatment, says: "In all the cases of incipient pulmonary tuberculosis, the results have been marked and highly satisfactory. In the cases, farther advanced, the results have not been so good but in almost every case, even in the most advanced ones, the patient has shown a very marked temporary increase of bodily weight immediately afterwards, with a decided amelioration of cough, fever, night-sweats, and debility." Unfortunately, no exact clinical reports are added to this paper, nor any more exact details. This increase of appetite is, by the way, reported by many who have also used trypsin for the treatment of cancer (Comp. full literature in *Pinkuss. Medizinische Klinik*, 1907, Nr. 28 and 29).

One of my cases will be found quite illustrative.

Suppurative tuberculosis of the ankle with sinuses; a few injections of trypsin produced clearing up of the ulcers and sinuses, firmness of the fungoid tissue, and a transformation of the squamous, granulating masses into compact, connective tissue. These local changes were accompanied by a remarkably prompt improvement of metabolism, and in general condition. The patient gained 2 kilogrammes in 6 weeks!

Any attempt to account for these obvious and definite effects must be premature; directly we leave the region of purely empirical clinical observation, we tread upon very uncertain and practically uninvestigated ground. I recommend a study of the very interesting publications of M. A. Cleaves, to my knowledge the first to undertake an exact clinical investigation of the changes occurring in the organism under the influence of trypsin injections, and of a recent publication of Balint and Molnar on the influence of expressed pancreatic juice on the blood circulation.

OTHER CLINICAL OBSERVATIONS.

Without attempting any degree of completeness, I should like to point out merely those publications which cover the same ground as this paper, in which I am glad to note, that in the great majority of cases my observations have amply been confirmed.

Kantorowicz, Borszeki, and Turan, who published an account

PLATE XXIII.



FIG. 6. *Sitta carolinensis*, Linn. (Plate XXIII). (Continued)

PLATE XXIV.



Fig. 1. The right leg and foot, showing the sole of the foot.



Fig. 2. The right leg and foot, showing the sole of the foot.



Fig. 3. The right leg and foot, showing the sole of the foot.

of 98 cases of different types of surgical tuberculosis treated in the surgical clinic of the Budapest University; Brüning, of Giessen; Schiller, of the clinic of Gersuny, Vienna; all report the immediate and favourable influence of trypsin upon tuberculous processes.

E. Bircher, in a very able paper, has laid down the general outline of this research and a general survey of the literature. M. Brandes, of Kiel, had to contend with the same difficulties which I encountered at the outset, and, at the time of his first publication, did not seem inclined to be much in favour of the trypsin treatment, although doing full justice to the good results he had obtained.

In his résumé of the conservative treatment of surgical tuberculosis, read before the 16th International Surgical Congress, Klapp expressed his views on the trypsin therapy as follows:—

“For the abscess-forming types of local tuberculosis, the trypsin treatment affords the best conceivable prognosis. The suppurations, which sap the forces of the patient, are soon brought to a full stop. The best results with trypsin have been obtained until now with tuberculosis of the synoviæ of the mucous follicles, and the tendinous sheaths. In all these forms, trypsin therapy *stands far above all other forms of conservative treatment.*”

THE TECHNIQUE OF TRYPSIN INJECTIONS

One of the most important points, which one is apt to overlook at the beginning—I trust I shall be excused for drawing attention to something so very obvious—is the fact that ferment solutions are destroyed by heat above 80° C., and that they generally contain enough protein to clog the needles on heating.

The second point—apart from the quite obvious demands of cleanliness and sterility of the injection—is this, that the injection should be *strictly subcutaneous*. After injection, the trypsin is distributed beneath the skin by gentle massage.

Since the sensitiveness of various individuals towards trypsin varies, it is as well to keep patients within easy reach after the first injections, and to be prepared for the emergencies mentioned. It would certainly not be amiss to watch the urine of the patients, and to put them on a bland diet.

The very important question, whether to inject locally or remotely, has already been touched upon. There is certainly no advantage in a *remote* muscular injection.

In dealing with tuberculous abscesses, we have to make use of the

technique of puncture or of injection. Puncture is carried out in the usual way, using either a trochar of medium size or a syringe with a wide canula, with proper regard to the usual measures of precaution. The trochar is pushed into the abscess obliquely, avoiding reddened patches so as not to cause perforation. It is best to use ethyl chloride to anaesthetize the site of injection. Altogether I inject 1-2 c.c., and, since the Fairchild solutions contain 60 per cent. glycerine, I prefer to dilute them for use with 10 parts of sterile physiological salt solution. No pain follows these injections. As to the number that depends upon the extent and severity of the case; very often 2-3 are quite sufficient, in other cases more have to be used in order to procure a definite cure.

Sometimes, it may happen that the skin gives way during treatment, but even this is not so alarming as hitherto has been held. The abscess will soon empty its contents and dry up without further complications.*

Sinuses, wherever their situation and point of issue, are not simply rinsed or packed with trypsin; I have found it to be by far the better plan to inject *into the surrounding parenchyma*, moving the needle so as to inject into as many places as possible around and into the sinus. In the case of ulcer, I inject around it and underneath its base.

In synovial hygromata, I inject simply into the synovial sheath. To avoid too violent reactions, I find it useful to start with 0.2-0.5 c.c., and to use larger quantities only after 3-4 injections.

In tuberculosis of the joints, I inject directly into the parenchyma. 1-2 c.c. trypsin is injected at intervals of 6-8 days—and even at shorter intervals—with an ordinary Pravaz syringe. The skin is carefully cleansed and disinfected, and the injections are made partly directly into the joint, partly into its surrounding tissue. While in all other cases I dilute the Fairchild injections with 4-10 volumes of saline solution, I mostly abstain from this dilution in these cases in order to get a stronger effect—*combining the action of glycerine with that of trypsin, and relying upon the body-fluids to dilute the trypsin sufficiently for its best effect.*

When to stop the injections, is rather difficult to say, since the changes take place only step by step. But, as I have never seen anything in the nature of anaphylaxis, there is scarcely any reason to fear overdoing the injections. If a more severe reaction takes place, time should be allowed for the reaction to pass off.

The capsular ligament will often be found extended by exudation, and this fact makes the administration of injections all the easier. It seems, however, that, for complete success, the parts affected should be brought into immediate contact with the trypsin, since the trypsin is not sufficiently diffusible. It would, therefore, be advisable to change the site of injection as frequently as possible. I would remark here quite briefly, that *I am at present engaged in elaborating a method of injecting trypsin intravenously, especially in combination with ligature of the limb.* For the same reason one should not be afraid to inject with a fair amount of pressure, so as to distribute it as extensively as possible. No apprehension need be entertained lest the trypsin be present in too large an excess, for I have never found it exert

* When once the pus gets thinner, it is quite safe to use smaller canulae which may even prevent the formation of sinuses entirely.

any untoward action upon sound tissue, cartilage, or bone, even in my numerous experiments on dogs.

Parenchymatous injections are very painful, especially as the scar formation proceeds very vigorously after the first injection, so that it soon becomes necessary to inject it with a fair amount of pressure. This refers only to the injection itself; the after-pain never lasts long, nor is it by any means intolerable. Not even delicate children complained very much of pain a few minutes after injection. In this, trypsin differs, with advantage, from various other injections, including iodoform-glycerine.

Sometimes, with very sensitive patients, I add to the trypsin injection some novocain. I do not recommend the mixture to be prepared as a stock solution; it is best prepared afresh immediately before use.

CONCLUSIONS.

The general conclusions from my own abundant material, and from the experiences of others, which have been sufficiently extensive to permit of an opinion on a subject so comparatively new and difficult, may be rendered concisely in a few words:

1. There can be no doubt that injections of trypsin have a definite curative action upon the processes of surgical, *i.e.*, localized tuberculosis.
2. The action is directed selectively against the fungoid purulent masses, and at the same time it is instrumental in producing healthy granulations.
3. Although with the material used, the growth of the tubercle bacillus remained unimpaired, it is an indubitable fact that, in the course of the trypsin treatment, the tubercle bacilli disappeared entirely from local affections.
4. The treatment is simple and devoid of any danger. Even out-patient treatment has given full satisfaction.
5. A point of greatest importance is the selection of the proper preparations for injection. I am now using the *Injectio Trypsini* (Fairchild). This, since it contains 60 per cent. glycerine, has to be diluted with sterile saline solution, 2-10 parts. The dosage is 1 ampoule of 1 c.c. 1-3 times a week.*
6. Even previous to the local changes, a general improvement is observed to follow trypsin injections; lessening, and even complete cessation, of pain, dis-

* Until a definite change for the better is noticed, when the frequency of the injections may be left to the discretion of the practitioner.

charge, and night sweats, and, chiefly, a very marked improvement of appetite.

Looking back over a fairly extensive experience, I find the results to be so free from ambiguity and so promising, that I would recommend this as the treatment for choice in all cases for which the use of iodoform-glycerine is usually recommended. The advantages are obvious; in the first place, the quantities injected are much less, the pain is not nearly so intense, the danger of intoxication, met with not so very rarely in the iodoform treatment, practically nil. Although there seem to be cases of increased susceptibility to the injection of trypsin, there is never any real danger to be apprehended, while the cases of very grave intoxication or even death, as reported in the literature of iodoform treatment, are absolutely excluded.

As to the question of particular indication, I recommend trypsin in all cases with sinuses, and those with a tendency to form them, and, in addition to these, in all kinds of abscesses. Its particularly good effect permits it to be used even *at the risk of forming a sinus*, a result usually very much to be avoided.

At the same time, it must be acknowledged that trypsin injections *do not permit of a schematic treatment*. The surgeon must be guided merely by the progress of the patient. There is no harm in frequent injections, nor in not too long intervals. Once the first signs of the local reaction have appeared, and these always come suddenly, the injections may even be stopped altogether; although, obviously, one would prefer to continue giving them until the improvement has become a certainty.

As regards the treatment of the different affections of the bones and joints, the results obtained by myself seem certainly to deserve the fullest attention. Of course, the method will fail now and then, but given proper preparations, I have found it to be powerless only in cases in which the response has been hindered by a partly depressed general condition. In all cases in which, in spite of numerous injections, the local affection showed unrestricted development, the organism seemed to be absolutely devoid of any power of response to *any*

stimulus. Whether it will be possible to rouse even such desperate cases by means of climatic treatment, or perhaps by injections of tuberculin, time will show.

To me it seems important that I was able to obtain my results practically only by the use of trypsin injections, and that most of the treatment was carried out on out-patients—a most important matter for the general practitioner.

Even in the case when other, even exclusively surgical, treatment is determined on, I think the trypsin injections would not be out of place, if only for the almost immediate effect on the general condition of the patient, whose frame of mind improves with the prompt improvement of general metabolism and appetite.

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SURGICAL TUBERCULOSIS OF THE COLON, RECTUM, AND ANAL CANAL.

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TUBERCULOSIS may be met with in the large intestine:—
(1) as a part of a general miliary infection; (2) as a general or localized ulcerative colitis, when it is usually secondary to tubercle elsewhere; (3) as a localized hyperplasia in the cæcum or at one of the flexures of the colon.

The hyperplastic type of tuberculosis is of special interest to the surgeon. Not only does it attract attention because it is or may be amenable to operative treatment, but also because it presents characteristics which differ from those of other forms of tubercle, and because clinically, it closely simulates carcinoma.

Hyperplastic Tuberculosis of the Colon.—Unlike the ulcerative form of intestinal tuberculosis, the hyperplastic is not as a rule due to the swallowing of sputa from infected lungs, but occurs as a primary manifestation, or at any rate as a local infection, independent of pulmonary or general tuberculosis. To the ulcerative form it bears somewhat the same relationship that fibroid phthisis does to acute pulmonary tuberculosis. Although the disease is usually confined to one part of the colon, most frequently the cæcum, occasionally two or three distinct lesions may occur together. In 88 out of 100 cases collected by Lockhart Mummery, the cæcum and ascending colon were the parts involved.

The prominent characteristic of this condition is *tumour formation*, resulting in a close resemblance to malignant disease. It seems probable that in the past the condition has often escaped recognition, and given rise to a mistaken diagnosis of carcinoma, and it is more than likely that not a few recorded cases of cure of supposed cancer of the large intestine come, in the absence of microscopical examination, under this category.

Both these two conditions give rise to a movable tumour,

associated with colic, and it may be, obstruction. Fixation is a late condition in both cases, and so too is secondary suppuration. Pain, tenderness, and inflammation are conspicuous by their absence in the early stages. Neither age nor sex will aid the diagnosis, for the middle period of life claims the majority of cases, and to neither sex is a preference given.

The following case, which was under my care at St. Bartholomew's, illustrates the clinical condition met with in the cæcum:—

A woman aged 46, was admitted on September 4th, 1910, with a six months' history of frequent attacks of colicky pains in the abdomen, and the occasional passage of dark blood *per rectum*. She had not suffered from diarrhoea or constipation, but had lost weight rapidly. On admission nothing abnormal could be felt either *per abdomen* or *per rectum*. On examination under an anæsthetic, a well-defined sausage-shaped tumour could be felt in the region of the cæcum. The abdomen was opened on September 12th, and the tumour felt was found to involve the cæcum and part of the ascending colon, and at first sight suggested an intussusception. On further examination, it was found that the bowel wall in this region was considerably thickened, and extremely resistant to pressure. The infiltrated area was sharply defined both above and below. A few enlarged glands were seen in the neighbourhood of the cæcum. A lateral anastomosis was made between ileum and the transverse colon, close to the hepatic flexure, and the abdomen closed.

On September 29th, the abdomen was again opened, and the involved portion of gut resected. The patient made a good recovery from the operation, and is now in very good health.

The following is a description of the specimen, as drawn up by the Assistant-Curator of St. Bartholomew's Hospital Museum:—

"A resection of the intestine, which includes $2\frac{1}{2}$ in. of ileum, cæcum, appendix, and $8\frac{1}{2}$ in. of ascending colon. The ileum appears normal. The mucous membrane lining the posterior wall of the cæcum appears healthy, but that of the anterior wall has a great number of polypoid villi varying in length from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. The muscular wall is hypertrophied, and there appears to be more fat than normal. In the colon a similar condition is seen, except that the polypi are longer up to a point 3 in. above the ileo-cæcal valve, where a stricture partially occludes the lumen of the intestine. From this point, and extending 5 in. along the colon, the mucous membrane is covered with large, flat, tag-like processes in great numbers. An especially long and broad example is to be noted springing from the posterior wall. This appearance of the mucous membrane ceases abruptly at a point $\frac{1}{2}$ in. below the end of the specimen, and the mucous membrane beyond this is normal. The line of demarcation at both ends between the normal and abnormal mucous

membrane is very definite and almost annular. There seems to be more fat than normal in the outer wall and in the appendices epiploicæ. The muscular coat is greatly hypertrophied. Some small glands were found on the posterior aspect."

It is a noticeable feature in hyperplastic tuberculosis that fibrosis is seldom followed by ulceration. The mucous membrane, though greatly hypertrophied and mammilated, is usually intact. Consequently, there is no inflammation or absorption with pain and rise of temperature, signs which so often serve to distinguish the inflammatory from the malignant tumour. The tuberculous tumour pursues a chronic course from the first, until a stricture results and intestinal obstruction follows.

In the case just recorded, little doubt existed in my mind that I was dealing with a case of malignant disease, nor was this doubt dispelled without a microscopical examination. The absolute proof of tuberculosis was wanting, because no tubercle bacilli could be demonstrated, but the resemblance to other specimens of hyperplastic tuberculosis and the evidence obtained from the recorded literature of the subject leave no doubt of identity in my mind.

When a specimen of this condition is examined, the most conspicuous feature is the great thickening of all the coats of the bowel, uniformly distributed round the lumen, which makes the bowel resemble a solid tube, and to which the name of "gas-pipe colon" has been given. Stenosis and stricture either general or localized to one portion of the tumour ultimately occurs. Once a stricture has occurred, ulceration not infrequently follows, a natural sequence to intestinal stasis in an obstructed segment of bowel. Polypoid pedunculated out-growths from the mucous membrane are met with in most cases. They are covered with epithelium, and show, under the microscope, marked round-celled infiltration.

Both the subserous and submucous coats share in the hyperplasia, although in individual cases one or the other may predominate, and to so marked an extent that two types, the submucous and the subserous, have been described. The glistening translucent appearance of the thickened muscular coat, on naked-eye section, may be compared to the appearance of a colloid carcinoma of the stomach wall of the

"leather-bottle" type, and had this term not been commandeered for a peculiar type of gastric carcinoma, it might well have been appropriated for hyperplastic tuberculosis of the colon.

Tubercles and giant cells may be met with in the submucosa in considerable numbers; on the other hand, they may be extremely scarce. In some instances, as in the case recorded, they cannot be demonstrated, although in other respects the specimen can claim an identity sufficiently strong to establish a diagnosis. Microscopically, the predominating feature is a round-celled infiltration with extreme fibrosis, especially marked in the submucous coat in some cases, and in the subserous in others. In only a few cases have caseating tuberculous foci been met with. The serous coat seldom contains tubercles, a feature so characteristic of tuberculous ulcers of the intestine.

In the absence of microscopical evidence of the tubercle bacillus, guinea-pig inoculation should be carried out to establish the diagnosis. If this course is adopted, and the condition more generally recognized, I believe it will be found that the disease is not so rare as the scanty literature on the subject would lead one to suppose. Apart from malignant disease, the condition may be simulated in some instances by diverticulitis of the colon with pericolitis, but the identification of diverticula should clear up the diagnosis.

From what has been said, it will be gathered that the symptoms of this condition are those of carcinoma of the colon. The presence of blood in the stools and progressive loss of flesh somewhat favour a diagnosis of cancer. The absence of these, and past or present evidence of tubercle elsewhere, somewhat favour a diagnosis of tubercle.

The treatment consists in establishing a diagnosis by exploratory operation, in the relief of obstruction by colostomy or short circuit, and the extirpation of the tumour whenever possible.

It should be mentioned that glandular involvement usually occurs. In some instances, the glands can be removed successfully with the tumour.

Tuberculous Ulceration of the Colon.—If the tubercle bacillus gains an entrance into the intestine through infected milk

or other food, a primary tuberculosis may result, but it is extremely rare to find post-mortem evidence of tuberculous ulceration of the intestine without evidence of tubercle elsewhere, either in the bronchial glands, in the lungs, or other organs. Professor Sormani has shown that the gastric juice of the pig is capable of destroying the vitality of the tubercle bacillus, and, doubtless, the human gastric juice under healthy conditions is equally protective.

Unlike tuberculous ulceration of the small intestine, which is mainly a disease of childhood, tuberculous ulceration of the large intestine is most commonly met with in adults, and is, in the great majority of cases, secondary to advanced pulmonary disease. It has a predilection, like the hyperplastic form, for the cæcum and ascending colon, but is met with throughout the large intestine as a diffuse infection, and less commonly as a localized disease in other parts of the colon. Tubercles are usually to be seen on the serous coat, and will be found in great numbers in the caseating areas at the heaped-up edges. Though the ulcers tend to encircle the bowel, they rarely produce stricture or obstruction. Occasionally perforation into the general peritoneal cavity occurs.

Perforation of an ulcer of the colon is most often met as a complication of malignant disease, and though it occurs occasionally in enteric fever, dysentery, and other forms of ulcerative colitis, it is certainly rare in cases of tuberculous ulceration. If ulceration advances to the stage of perforation, protective adhesions not uncommonly precede perforation, and the result is either a localized abscess or a faecal fistula opening into another part of the bowel or into the abdominal wall, the rectum, or vagina. The glands are frequently, but not always, infected. Large caseating glandular tumours may form, which will occasionally rupture, and give rise to general tuberculous peritonitis.

The symptoms of tuberculous ulceration do not differ from those of other forms of ulcerative colitis. The association of diarrhoea with blood and pus in the stools, combined with the physical signs of phthisis, should lead to a diagnosis, which will usually be confirmed by a microscopical examination of the discharge.

The treatment of this condition can only be palliative and

symptomatic, if active disease of the lungs co-exists. In the rare cases in which the condition is met with independent of pulmonary disease, treatment by means of appendicostomy and irrigation should certainly be tried, though without much hope of permanent benefit.

Tuberculous Ulceration of the Rectum and Anal Canal.—

When tuberculous ulceration occurs in the colon it usually extends to the rectum, and will readily be recognized with the sigmoidoscope. In an early stage the ulcers are small and shallow, and small grey nodules may be seen. A common situation for an ulcer is on the upper surface of one of Houston's valves, where it may easily be missed with the sigmoidoscope unless carefully looked for. Tuberculous ulceration of the rectum advances very rapidly, especially when associated with advanced phthisis. The ulcers enlarge and fuse together, the edges become undermined, and in a few weeks little of the normal mucosa may remain.

High up, perforation may occur into the peritoneal cavity; low down, the ulceration may extend into the bladder or vagina, resulting in recto-vesical or recto-vaginal fistula. More often ulceration invades the ischio-rectal fossa, and a tuberculous fistula in ano results (*vide infra*). Occasionally the stress of the ulceration falls on the anal canal, followed by fistulous tracks in all directions. Fibrosis with resulting stricture is rare in tuberculous ulceration of the rectum, but it is occasionally met with.

As in other forms of infective proctitis, treatment is most disappointing. When associated with ulceration of the colon, appendicostomy, combined with irrigation both from above and below, should be employed when the condition of the patient permits. Some temporary improvement in the rectal condition, and often considerable relief of pain, may be obtained with ionization with a solution of zinc sulphate. An excellent electrode for this purpose is made by Messrs. Allen & Hanburys.

Tuberculosis of the Anal Skin.—This is a rare condition, but a few cases have been met with at St. Mark's Hospital. Small greyish nodules may be observed close to the anal margin, quite unlike the flattened moist condyloma, and not to be confused with the tuft-like anal papilloma. If these are not promptly excised, a tuberculous ulcer results and quickly

extends. The condition occurs independent of recto-anal tuberculosis, and the term "verrucous tubercle" has been given to it.

Tuberculous Fistula in Ano.—Whereas in the great majority of cases the non-tuberculous fistula is the sequel to an abscess, ischio-rectal or anal, and is acute in origin, the tuberculous fistula is from the first usually a chronic condition, and commences insidiously. The tuberculous fistula is characterized by extensive undermining of the skin, which is blue and boggy, with little or no induration of the surrounding parts. The internal opening between the sphincters is usually large, ragged, and ulcerated, and the external opening, instead of presenting a button-like granulation, is patent and irregular. Owing to the absence of acute inflammation and induration, and consequently of pain, the condition may not attract attention *in the early stages*. In the majority of cases pulmonary tuberculosis is present, and is usually advanced.

Although in cases of tuberculous fistula, phthisis is more often present than not, fistula is a comparatively rare complication of pulmonary tuberculosis. Dr. Hugh Walsham found that, at the City of London Chest Hospital, in 891 cases of tubercle of the lung, fistula was present five times and ischio-rectal abscess twice, and that in 133 post-mortems, after death from phthisis, there was only one fistula in ano. A fistula occurring in a tuberculous patient is not necessarily tuberculous in origin, though it is liable to become so if neglected. A non-tuberculous fistula in a tuberculous subject, if treated early, will readily heal, whereas a fistula, the result of active tuberculosis, will not heal so readily if the disease of the lung is also active.

If the fistula is tuberculous in origin, the tubercle bacillus will usually be found either in the discharge or in the walls of the sinuses. It is generally believed, and some text-books support the view, that about 10 per cent. of all cases of fistula are tuberculous. I believe that this figure is far too high, and that at St. Mark's Hospital the percentage of tuberculous fistulæ is not higher than 3 per cent.

Many cases of fistulæ spend a very long time in hospital, and some suffer many operations, often from house surgeons who have had small experience of fistulæ. These cases sometimes get the credit of being tuberculous because of their

protracted convalescence, whereas in reality the delay is often due to imperfect operation.

Treatment of Tuberculous Fistula.—It was a tradition in the past that tuberculous fistulæ should not be operated on. It was contended that the fistula acted as a safety-valve to the lungs, and that relief or cure of the fistula accelerated the pulmonary mischief. At the present time no such belief as this holds ground. There can be no doubt that progressive ulceration, subcutaneous fæcal extravasation, and painful defæcation can have no beneficial effect on the local condition in the lungs or on the general condition of the patient. On the other hand, considerable relief, both bodily and mental, can be obtained by operation, if the cases are judiciously selected, and in a certain percentage of cases a complete cure of the fistula will result. Certain precautions, however, must be observed.

If a patient is the victim of acute phthisis and cannot live long, no operation is advisable. The most that should be done is to relieve pain by simple incision under local anæsthesia. If a radical operation is attempted, no benefit will accrue; operation will be followed not by healing but by progressive ulceration, and the last state will be worse than the first. If a patient has been the subject of active phthisis, but is, at the time of consultation, on the road to or far advanced towards recovery, more active treatment may be employed and with more prospect of success. In these cases the external sphincter should be dealt with sparingly, and the internal religiously avoided. It is a noticeable feature of tuberculous fistula that the sphincters are weak and flaccid, and do not readily recover their tone when once divided.

In cases of tuberculous fistula with no evidence of tubercle elsewhere, early radical operation is most important, to remove a possible source of general infection. A general anæsthetic, and especially ether, should be avoided in all cases in which pulmonary disease co-exists. Either local or spinal anæsthesia should be used. The patients should not be confined to bed after the first day, nor should they be kept in the recumbent position. Fresh air and sunshine, with cheerful surroundings and good food, are important details in accelerating recovery. The consumptive, who develops a fistula, takes a gloomy view of life, and the success or failure of the surgeon depends not a little on apparent trifles.

TUBERCULOSIS OF THE STOMACH AND
INTESTINES.

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IT is very rarely that a tuberculous lesion of the stomach is found at post-mortem examination, while tubercular disease of the intestine is extremely common. There must be some reason for this difference in susceptibility, for both stomach and intestines are equally exposed to attack by tubercle bacilli. Some have asserted that the gastric juice is antiseptic, and that the free HCl is able to destroy the bacilli, or at least to diminish their virulence. It has been found experimentally, however, that contact of bacilli for four hours with gastric juice does not seem to impair their growth or power of infecting animals. Moreover, in a case of pulmonary tuberculosis in which infected sputum is swallowed, the bacilli pass through the stomach, and leave it unscathed, yet when they reach the intestine, extensive ulceration occurs. Barbacci has suggested that the relative immunity of the stomach may be due to the fact that it contains only a small amount of lymphoid tissue, while lymphoid follicles are abundant in the intestine. It has clearly been shown that lymphoid tissue is a specially favourable situation for the development of the tubercle bacillus.

TUBERCULOSIS OF THE STOMACH.

This is very rare, only about a dozen authentic cases being on record. Primary disease of the stomach has never been found. Van Wort¹ describes a tuberculous mass in the muscular wall of the stomach; a unique case. Large tuberculous ulcers have been described. In other cases, a caseous lymph gland has softened, become adherent, and ruptured into the organ, as in a case described by Chiari.² The condition would present no definite symptoms during life, and would not be diagnosed. Treatment should be directed to the primary focus, and not to the secondary gastric lesion.

TUBERCULOSIS OF THE INTESTINES.

The question whether the intestine can be the seat of primary infection by tuberculosis is still actively discussed. R. Koch³ claims that infection of human beings through food (especially tuberculous milk) passing into the intestines is very rare, and he considers that it is unnecessary to take measures to prevent the consumption of tuberculous milk. This view is strongly opposed by other authorities, the following objections being raised against it :—

- A. Many cases have been described in which an epidemic or tuberculosis has been traced to the infection or milk from cows with tuberculous udders.
- B. Many cases have been described in which tuberculous lesions in children have been confined to the intestine and the mesenteric glands. Macfadyen and MacConky found virulent tubercle bacilli in the mesenteric glands of five such cases.
- C. Now that the differences between the human and bovine bacilli are recognized, it has been possible to demonstrate bovine bacilli in the mesenteric glands of children suffering from tuberculosis.

On the other hand, primary bowel infection is not common ; in England, it appears to be more common than in Germany and France. Of all cases, 18 per cent. were primarily intestinal in the English series of statistics, 4 per cent. in the German, and 1 per cent. in the American. It occurs most frequently in children, and is very uncommon in adults. The comparative rarity of primary intestinal tuberculosis does not, however, necessarily make infection by tuberculous milk an uncommon event. One has only to look at a baby's throat an hour after a feed, and see the milk curds about the tonsils and fauces, to realize the possibility of the very common tonsillar infection being due to tuberculous milk.

Secondary intestinal tuberculosis is very common, and may be due to the following causes :—

- 1. In chronic pulmonary tuberculosis, the intestines are involved in more than one half of the cases. The lesions are chiefly in the ileum, cæcum, and ascending colon and are due to swallowing infected sputum.

2. In tuberculous peritonitis and tuberculosis of the mesenteric glands, descending from tuberculous bronchial glands or ascending from tuberculosis of the hip joint, secondary infection of the intestines may occur.
3. Primary tuberculous salpingitis may be followed by intestinal tuberculosis, as also may be tuberculous disease of the suprarenal glands.

CLINICAL VARIETIES OF INTESTINAL TUBERCULOSIS.

(A) *Multiple Ulceration*.—The most common seat of the ulceration is in the ileum, cæcum and ascending colon, though occasionally ulcers are found all through the small intestine, even as high as the duodenum, and may also be discovered throughout the length of the colon. There may be only four or five ulcers, but in many cases they are very numerous. The process always begins in the lymphoid follicles of the intestines, which become swollen, and then caseous degeneration of the central part of the follicle occurs. Rupture takes place, and a small crater-like ulcer is formed. It is the small solitary follicles of the intestine, which are chiefly involved. The growth of the primitive ulcer occurs along the transverse axis of the intestine in a direction, which corresponds with the lymphatics, as they accompany the blood vessels circularly round the gut. Eventually a complete "girdle ulcer" may develop. The edges of the ulcer are raised and irregular, and the base is infiltrated, the submucosa and the muscular coat being involved. On the peritoneal surface, small tubercles or a well-marked tuberculous lymphangitis can be seen. Peritoneal adhesions occur about the base of the ulcer.

The *symptoms* of multiple ulceration of the intestine due to tuberculosis are, as follows:—The onset may set in with fever, irregular diarrhœa and colic; often, however, it is quite insidious. Hæmorrhage from the bowel may occur early in the disease, and may be fatal (Osler⁴). Emaciation is marked and progressive, and symptoms may point to a chronic colitis, until definite signs of disease of the lungs occur. The finding of tubercle bacilli in the sputum, or in the fæces, will often settle the diagnosis. In children the symptoms of tuberculous ulceration of the bowels are often very obscure.

The *complications* of intestinal tuberculosis are :—

1. Perforation into the peritoneal cavity. This is rare on account of the adhesive peritonitis which occurs round the base of the ulcer; when it does occur, the peritonitis is rarely general, and a fæcal fistula usually results, the localized abscess pointing towards the abdominal wall generally near the umbilicus.
2. Stricture of the bowel may follow the healing of an ulcer. Tuberculous strictures are often multiple, and in most cases do not produce a great narrowing of the bowel.
3. Caseation of the mesenteric glands is a very common accompaniment of intestinal tuberculosis, whether primary or secondary. Great matting of the intestines occurs, and the formation of tumours by the enlarged glands or matted intestines is common. Softening of the caseous glands and pointing of the degenerated mass at the umbilicus are frequently found, and discharge of caseous material may occur for months.

(B) *Chronic Hyperplastic Tuberculosis*.—Since 1890, numerous cases have been described, in which tumours of the intestine in the neighbourhood of the cæcum have been found to be due to tuberculosis, although clinically they closely simulated cancerous growths. Most of the cases were between the ages of 20 and 40, and the sexes were affected equally. The tumours may occur in the ileum, cæcum, and ascending colon, rarely in the descending colon. The early symptoms are anorexia, flatulence, and functional digestive disturbance. Gradually increasing constipation is the usual condition, but diarrhœa with blood in the stools may occur.

Occasionally, uncomfortable sensations in the region of the cæcum lead to the discovery of a hard tumour which is generally painless and moveable. Soon the symptoms of chronic intestinal obstruction set in with colic, peristalsis, and distension of the small intestine. The tumour is found to be a dense fibrotic infiltration of the bowel wall with great narrowing of the lumen. The infiltration usually shades off gradually into the surrounding healthy bowel. Ulceration may or may not be present. Microscopically, there is no

sign of malignant growth, but a chronic inflammatory proliferation in which giant cells and tubercle bacilli can be demonstrated.

The diagnosis has to be made from carcinoma, sarcoma, chronic appenditis with adhesions, chronic intussusception, and actinomycosis. The existence of pulmonary tuberculosis and the presence of tubercle bacilli in the fæces are of importance in making the diagnosis. Often this is impossible, and it is only after resection of the bowel at operation that the nature of the tumour is demonstrated.

(C) *Tuberculosis of the Appendix*.—Tuberculous ulceration of the appendix may occur in association with tuberculous ulceration of the intestines. Opinions differ as to the frequency of appendicitis of tuberculous origin. I have several times observed cases in which abdominal tuberculosis started in the right iliac fossa, and then involved the rest of the peritoneal cavity. Crowder⁵ has published a case of chronic hyperplastic tuberculosis limited to the appendix, but, as a rule, the appendix is but rarely affected in this form of intestinal tubercle.

(D) *Tuberculosis of the Rectum*.—Fistula in ano occurs not infrequently in case of tuberculosis of the lungs, and in many cases the fistulous tract has been proved to be tuberculous.

TREATMENT OF INTESTINAL TUBERCULOSIS.

Hygienic treatment is of the first importance. When active symptoms are present, rest in bed in the open air is important. Residence at the seaside (Margate), or at a sanatorium, must be advised. The diet should be abundant. Plenty of milk, cream, and butter should be given, and pounded meat and chicken can be added as the patient improves.

Treatment by specific vaccines, such as tuberculin T.R., has not given markedly favourable results in a large number of children whom I have observed at Great Ormond Street Hospital. Possibly, it will be found that one of the other varieties of tuberculin will be more successful.

Inunction of oleate of mercury ointment (10 per cent.) should be given night and morning. Half-a-drachm should be rubbed well into the groin or axilla, and then covered with warm flannel. Rubbing of the abdomen itself is better avoided.

Offensive diarrhoea is best treated by a mixture of opium and bismuth, e.g., for a child of three years old, the following

prescription could be given:—

R	Tinct. Opii	-	-	-	℥iii.
	Bismuthi Carb.	-	-	-	gr. x.
	Mucil. Acaciæ	-	-	-	℥s.
	Aquam	-	-	-	ad. ℥ii.

A dessertspoonful thrice daily.

When the diarrhœa is better, cod-liver oil and malt should be given, at first in small doses, and then gradually increased. Creosote may be given with the cod-liver oil.

For the complications of intestinal tuberculosis, such as abdominal fistula, the appropriate treatment must be given. The occurrence of a fistula is of bad prognosis, and they often heal very slowly. In a case, in which drainage was defective, a rubber catheter was gently introduced and allowed to find its way for five inches among the coils of matted intestine. This provided free drainage, and the fistula rapidly healed up. Operations on these fistulæ are rarely successful, and often disastrous.

Strictures due to healing of tuberculous ulcers are often multiple, and if they cause obstruction, an anastomosis between the small intestine above the stricture and the sigmoid loop is the best procedure.

In chronic hyperplastic tuberculosis, very favourable results have followed resection of the tumours, and this should always be done.

Fistula in ano of tuberculous origin should be operated upon, unless the pulmonary disease is too advanced to allow of it. If possible it is better to excise the fistula rather than to lay it open and scrape it, for the latter procedure is commonly said to result in an exacerbation of the pulmonary disease.

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URINARY AND GENITO-URINARY TUBERCULOSIS.

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THE practitioner will probably never master the complexities of genito-urinary tuberculosis, until he has thoroughly learnt the rudiments of uncomplicated urinary tuberculosis. They are easily acquired, if the material studied be taken from the female sex. Three great general laws lighten the task considerably: the law of invasion, of selection, and of exacerbation.

1. *The Law of Invasion.*—This ranks first in importance. It deals with the chronological order in which the various parts of the urinary tract are affected. Of all parts of the urinary tract, the kidney is most liable to be attacked first by tubercle. The bladder is only implicated secondarily by the disease descending to it from the kidney. The inferential law is obvious. Suspect the kidney in every case of urinary tuberculosis in the female.

2. *The Law of Selection.*—Only one kidney is attacked.

3. *The Law of Exacerbation.*—The engrafting of pyogenic organisms upon a pre-existing tuberculous infection flares up the process and produces great destruction of tissue.

Inferential law.—Avoid any irrigation of the bladder, for this is particularly liable to induce a septic cystitis, and a chance depreciation of the healthy kidney, as well as increased destruction in its tuberculous fellow.

The next step is a due appreciation of the A B C of the pathology.

A. Tubercle bacilli or débris from some extra-urinary focus are swept into *one* kidney by the blood stream and lodge about the glomeruli. (Hæmatogenous infection.) A localized destruction ensues, the renal pelvis

is broken into, and the débris is carried by the stream of urine down the ureter.

- B. The combined tuberculous and renal toxins, set free by the destruction, have an especially irritant, scalding effect on the mucous membranes of the pelvis and ureter. They cause œdema, congestion, and, here and there, minute erosions of the surface. The process extends to the submucous and muscular layers of the wall, and finally causes *interstitial thickening*. The scalding action falls most severely on the ureteric canal, ureteric orifice, trigone, and vesical orifice. Its acuteness is an index to the severity of the local destruction of the renal tissue—not to its extent.
- C. In process of time, contraction occurs in the interstitial exudate. The capacity of the renal pelvis and bladder diminishes; the ureteric channel narrows; the orifices contract.

The clinical consequences of these changes are obviously above criticism. The narrowing of the ureteric channel from mere swelling of the mucous membrane may induce renal pain by back pressure, and, therefore, a pain in the loin which can be covered by the hand. If a plug of necrotic tissue is arrested in the ureter, a renal colic must ensue; but this symptom is rare in tuberculosis. The early scalding and the surface erosion of the ureteric orifice, of the trigone, and of the urethral orifice cause bladder distress both night and day—frequency of micturition, and pain in the urethra during the act. The congestion and swelling cause a little blood to be strained out in the effort to empty the bladder.

To repeat the three great facts of urinary tuberculosis:—

1. The kidney is the first section of the urinary tract affected, and only one kidney is at first implicated.
2. No thickened ureter exists without a diseased kidney.
3. The bladder is not affected by tubercle at first—it is merely scalded and, as such, its irritability is the sentient expression of a suffering kidney. This, then, is the psychological moment to interfere on the chance of cure.

SYMPTOMOLOGY.

This is clean cut in outline. Half the patients start with bladder symptoms like those of cystitis, and subsequently have one aching kidney. The other half begin by complaining of pain in one kidney, but subsequently they exhibit symptoms like those of cystitis.

The practitioner's pitfall lies in the prominence and insistence of the bladder distress in a large proportion of the cases. This deceives him, and causes him to call the disease "cystitis," and to treat it wrongly as such, whilst he overlooks the origin of disease in the kidney.

Onset. (a) The Vesical Type.—A young adult female is, either gradually or suddenly, attacked by increased frequency of micturition. Meatal pain occurs during, and at the close, of the act, and a little blood may appear at the end of the stream. Renal pain is noticed after some months, and is then experienced in the loin.

(b) The Renal Type.—Pain is experienced in the loin. The area can be covered by the palm of the hand. It is not continuous, and hardly severe enough for morphia. At first, it consists of attacks of pain which are relieved by fomentations, and with it there may be actual difficulty in micturition. It is noticeable that as the vesical distress increases, the renal suffering diminishes, unless true colic is suffered from. The urine is pale, pyuric, low in specific gravity, and contains tubercle bacilli.

DIAGNOSIS.

The practitioner is always on the alert, in unexplained bladder irritation, for the bacillus coli communis or the tubercle bacillus. Both infections induce the same symptoms at first, and both attack the kidney first. A clinical differentiation consists in the bacillus coli setting up an initial temperature, and even a rigor. A competent bacteriologist will furnish the diagnosis in 90 per cent. of the cases. The practitioner examines the base of the bladder either by the vagina or rectum *under chloroform* and detects in 84 per cent. of tubercle cases the thickened swollen ureter. He can now definitely say, *if tubercle bacilli are found*—that the disease is in the corresponding kidney. Enlargement of the kidney and temperature are rarely noticed in the early stages.

No reference is made to the precise knowledge which can

be gained by expert cystoscopy. It is out of the practitioner's sphere. Real assistance in the diagnosis by this means can only be afforded by those honestly skilled in the art.

TREATMENT.

It is held by most surgeons, though the question is still moot, that there is no hope of the spontaneous cure of a tuberculous kidney, and that nephrectomy is indicated. It is abundantly proved that by removing the offending kidney *early*, whereby the stream of irritating urine is cut off, the bladder will recover, in time, absolutely. It is certain that, under favourable circumstances, even without nephrectomy, ulceration of the bladder can heal spontaneously, and thick ribs of scar tissue result, but it is not accepted that the kidney can heal. It is, therefore, the first duty of the practitioner to raise the question of nephrectomy, and while it is being considered to reduce the bladder distress. The treatment for this varies according to whether the onset is vesical or renal.

A. *Vesical Onset*.—If the onset is distinctly *vesical* and *gradual*, the use of tuberculin (new T.R.) in small doses $\frac{1}{50000}$ mg. injected weekly, will relieve in the early stages.¹ Now and again, when the primary infection of the kidney is slight and there are no kidney symptoms, this method can be used with benefit and may apparently *cure* (5–10 years). It is not a cure, and should not be termed one.

If, however, the onset-symptoms are purely renal and not vesical, and there is severe renal ache, especially true renal colic, tuberculin must *not* be used, for it increases the swelling of the mucous membrane of the ureter,² and tends still further to block the outlet of the damaged kidney. It acts locally on the kidney tubercle, and increases greatly the destructive process.

Irrigation of the Bladder.—If the disease has come on very acutely, and the frequency is very severe (every 10 or 30 minutes), washing away the acrid toxins, by irrigating the bladder *aseptically* for a week, gives the greatest relief. Nothing but a weak boric solution is necessary.

Vesical irrigation after the first acute onset is useless; it

¹ Author: *Ulceration of the Bladder*, 1900, p. 44.

² Author: *Med. Soc. Trans.*, 1905, p. 242.

may even be dangerous, for bacilli coli or proteus may appear, become hæmatogenously carried to both kidneys, and increase the tuberculous destruction in the one, or depreciate the vitality of the other. It is a fair comment on wrong diagnosis and injudicious bladder treatment to remark, that the patients who show the best end-results are those whose onset symptoms are kidney pain, and who, therefore, come under the surgeon early and have nephrectomy performed, without the well-meant, but makeshift, Fabian policy of treatment by vesical irrigation.

The exhibition of sandal oil (m_x. in capsule after meals) often acts like a charm. If the vesical trouble has proceeded to ulceration, and the pain at the meatus is not only constant but knife-like on jarring the body, only opium will help. This is *best given with Fuchsine in pill* (gr. $\frac{1}{2}$ aa). Any of the tisanes—Pareira, Buchu, Triticum, Uvæ Ursi, Collinsonia, Stigmata Maidis, assist.

B. *Renal Onset*.—If the onset-symptoms are renal—pain or colic—and tubercle bacilli are found in the urine, and the cystoscope demonstrates the corresponding ureteric orifice to be altered in contour, or retracted, with its area around ecchymosed and blistered, whilst the other ureter is healthy and the urine from it free from tubercle, it is foolish policy to delay, the kidney should be removed cleanly. In the early renal pain, the drugs of most use are: (a) the liquid extract of sandal wood, not sandal oil, for the latter causes congestion of the kidney and increases the pain. (b) The urotropine group and either an opiate or a bromide.

Operative Interference. Nephrectomy.—What can be promised the patient if early nephrectomy is skilfully performed? A death rate of $\frac{1}{4}$ per cent. must be expected. If there has been no contamination of the perirenal bed, and the ureter is wisely dealt with, there should be, in favourable early cases, a primary closure of the wound, and the bladder distress should cease. *Operative delay* in pronounced renal tubercle—that which starts with renal suffering—or that in which the vesical symptoms are not ameliorable by tuberculin, means an increased death-rate, sluggish healing of wound, and incomplete recovery of bladder power.

THE FINAL STAGES OF NEGLECTED URINARY TUBERCULOSIS.

Presuming the case to have been overlooked, or aggravated what relief can be afforded to a patient passing urine every 10 or 15 minutes in pain, and often in great pain? The only relief that can be offered consists in removing the diseased kidney and transplanting the other healthy ureteric orifice, *with its sphincter intact*, into the bowel, or by bringing the ureter of the sounder kidney on to the loin and draining the urine into a bag. The bladder is then at rest.

URINARY TUBERCULOSIS IN THE MALE.

When we pass from considering the symptoms of the disease in the female to those in the male, we find ourselves in a country neither so open nor so safe. Cases of uncomplicated tuberculosis do occur in the male, it is true, but they are not common. Moreover, in those we meet with, we cannot but feel that there may be latent undetected tubercle in some genital avenue, which may nullify our efforts and vitiate our clinical conclusions.

The male cases, which seem above this criticism, suffer from the same onset symptoms as the female, and the grouping occurs in nearly the same proportion of instances. Thus, about half the cases commence with bladder distress, and half begin with kidney pain. The urine in either class does not vary greatly from the classical—a lowered specific gravity, an acid, milky, light-coloured, tuberculous pyuria. But the rule holds, that one kidney is primarily affected, that it should be recognized and certainly removed. The thickened ureter is, however, not easily felt per rectum in the male, the vas and seminal vesicles confusing the contour of the bladder base.

Striking differences exist between the sexes. Urinary tuberculosis in man, as a rule, evokes severer symptoms, shows but little tendency to repair, is especially prone to septic engrafting, and, therefore, to suppuration and destruction of tissue. The kidneys which are removed are generally abscessed; the bladders, cystoscoped even in early stages, show true tuberculous erosions. The death rate of nephrectomy is higher (6-12 per cent.). The end-results are not

so encouraging, the wounds heal sluggishly, sinuses are common, and the bladder does not recover so rapidly or so thoroughly. There is an especial tendency in the male to miliary tuberculosis or lung complication, as a direct result of the operative interference (Israel).

The practitioner diagnoses and treats the disease in the male, exactly on the same lines as those advised for the female ; but with this difference, he obtains from the bacteriologist the diagnosis of tubercle at the earliest possible moment. He does not in any way meddle with the bladder either by washing or sounding, for he recognizes that the tuberculous male is prone to septic engraftings, and is most intolerant of instrumentation. He recognizes that there may be scattered foci of undetected tubercle, which would resent the exhibition of tuberculin, cause constitutional disturbance, and, may be, induce septic changes ; so he uses it with the greatest caution, commencing with a dose like $\frac{1}{80000}$ mg., and watching the result most narrowly. Finally, if pain or colic point to renal origin, he advocates removal as soon as possible of the offending organ. The operating surgeon is equally cautious, and cystoscopes and nephrectomizes at one and the same time.

GENITO-URINARY TUBERCULOSIS.

This is relatively a frequent disease in the male. The practitioner strikes, mentally, for the originating focus, either the testicle or the kidney. Genital tuberculosis generally precedes the onset of the urinary symptoms, revealing itself as a hard monkey-nut-like mass in the tail of the epididymis. If it is not acutely inflamed, it may remain torpid and non-invasive for years (10-15) and urinary symptoms may also remain absent. The tendency, however, is to progress insidiously, creeping along the vas and "beading" it. As it is certain that, in many cases of epididymal tubercle, a similar deposit co-exists in the prostate (24 per cent.), it is of the utmost importance to eliminate any cause which will aggravate the prostatic deposit. The prostatic deposit is always explosive. The gland is in the midst of an absorbent mesh ; its nightly condition is one of congestion ; it is open to septicity from coition. Hence, the chances of the disease hæmogenetically affecting the kidney, or directly invading the

bladder base, are great if the focus is disturbed.

Both treatment and prognosis turn, and only turn, on whether the kidney is involved prior to the bladder or not. But first a word about the genital infection.

GENITAL TUBERCULOSIS.

A young male applies for advice concerning a tuberculous deposit in the epididymis. If it is not actively inflamed, and if the prostate has a similar deposit in it, it is wise policy to leave it alone, treat the patient with lime, either lime water or some palatable calcium salt, good feeding, fresh air, and avoidance of cycling or any chance of testicular injury or urethral infection.

Should the tubercle be only in the testicle and the vas not be beaded with tuberculous knots, let a loop of the vas be resected, and the cut ends sealed with the cautery. If the other testicle become similarly affected, let it be treated similarly. The prostate is rendered less active by vasectomy, and the chance of invasion along the vas is minimized. Epididymectomy is futile.

A *badly* suppurating tuberculous testis should be removed, and the patient warned that the other testis may become involved. As the operation tends to detonate any prostatic lesion, it is better to incise a collection of pus if it is indolent, small and single, or even to allow it to discharge spontaneously if it seems likely to do so. When the symptoms marking invasion of the mucous membrane occur, or if they arise coincidently with the genital invasion, for it is often difficult to say exactly from which quarter the bladder is affected, whether from kidney or prostate, the real difficulty of the disease begins. If there are marked renal symptoms (pain, tumour, temperature), the kidney should be removed, quite irrespective of tubercle in the genital tracts.

But, and it is wise to reiterate this, there may be, and often are, no renal symptoms, no cystoscopic change in the ureteric orifices to guide the surgeon, no tubercle by the ureter catheter, and no evidence as to the co-existence of any deposit in the kidney. The symptoms may be purely vesical and generally when this is so, the symptoms will be severe and protracted. Various suppurative processes are likely to

occur, each to be treated as the testicle was originally treated—gently but firmly if possible, ruthlessly and radically if unavoidable; thus the vesicles may suppurate, and the complication may be so dangerous that the surgeon may have to resect one or both, but generally the pus makes its way to the perineum or buttocks, and many sinuses are formed.

The bladder loses its mucous membrane little by little, until the thickened and contracted viscus is bare with the exception of the trigone and orifices of the ureters. Incontinence of urine sometimes ensues: when it does, so much the better, for the vesical pain is lost. This vesical destruction induces septic renal tuberculosis from absorption, septic pyelitis ensues, and the course is still further downward.

TREATMENT.

Medical.—This is on the same lines as advocated for the woman, but tuberculin is used with infinitely greater caution, and its value is extremely doubtful. Irrigation is suicidal when the prostate is implicated; the pain it causes is intolerable. Opiate by the bowel is of extreme value.

Surgical.—Attempts have been made to relieve those who are not incontinent by opening the bladder and scraping. It is unsurgical, and merely courts disaster. Its only result is still further to contract the bladder and leave an open, unhealable fistula. The disease is often too advanced and the patient too debilitated, when the surgeon is permitted to interfere, to offer much hope of relief by placing the ureteric orifice in the bowel, but one or both ureters can be placed on the loin and drained into a bag; the patient is then in peace and comparative comfort.

The prognosis varies according to whether the kidney is involved or not. Patients have lived with marked genito-urinary tuberculosis for as long as 30 years, but then the disease was confined to the lower urinary tract, and fibroid and calcareous changes in the deposits were a marked feature in the case.



TUBERCULOSIS OF THE LARYNX.

By SIR ST. CLAIR THOMSON, M.D., F.R.C.P., F.R.C.S.

Laryngologist to King Edward VII. Sanatorium, Midhurst; Professor of Laryngology, and Physician for Diseases of the Throat in King's College Hospital.

INTRODUCTORY.

TUBERCULOSIS of the larynx is a complication of tuberculosis of the lungs. The mistake is still sometimes made of regarding consumption in the throat as a more or less localized phenomenon, somewhat comparable to tuberculosis in a joint or in the conjunctiva. It is a fact that a few, a very few, cases of primary tuberculosis of the larynx have been verified, by the post-mortem showing that the lungs were unaffected. But these cases can be counted on the fingers of both hands, and if we meet with a laryngeal case in which no pulmonary change can be detected, it is simply because the chest lesion escapes our present methods of investigation.

FREQUENCY.

Tuberculosis affects the larynx more frequently than any other specific disease. There are, to-day, in the United Kingdom, from 80,000 to 100,000 patients suffering from it and requiring our help; and its development and course have an important bearing on prognosis. Post-mortem examination shows that the larynx is involved in quite half the number of all fatal cases. Therefore, one out of every two cases which ends fatally will require consideration and relief of laryngeal symptoms. The affection is the rarer the earlier the pulmonary disease; in sanatoria, where laryngeal cases are avoided, about 6 per cent. are found to have tuberculosis of the larynx, but in the third stage of pulmonary tuberculosis this disease is discovered in the larynx in 72 per cent.

PATHS OF INVASION.

Infection of the larynx from the lung may take place (a) from the surface of the mucous membrane by the sputum, or (b) from the sub-mucous area, where the bacilli arrive

from the lungs by the blood and lymph streams.

Space prevents a study of these two paths, but one practical lesson is that, to save or cure the larynx, efforts should be made to diminish and sterilize the sputum; another lesson is, that the larynx may be affected in cases in which there is no sputum.

PREDISPOSING CAUSES.

Tubercle attacks the larynx in male consumptives twice as often as in females. It is most frequently met with between the ages of 20 and 40. It is rare, though not unknown, in children under 10. It diminishes both in frequency and severity as age advances. Chronic catarrh, sedentary and dusty occupations, syphilis, alcohol, and tobacco are all predisposing factors.

SYMPTOMS.

We must not forget that in early or slight cases there may be no subjective symptoms, so that the larynx should be examined systematically in every case of pulmonary tuberculosis. Cough is not a common symptom. Subjective sensations in the larynx and changes in the voice generally attract attention to the region, long before the onset of pain, tenderness, and dysphagia.

EXAMINATION.

It would require a handbook and a very completely illustrated atlas to give anything like an adequate description of the lesions met with. Even with such aids, it must be confessed there are many cases in which only the trained eye can make out the characteristic local changes, or these are revealed by the alterations seen during the progress of the case. They vary in situation, extent, age, and intensity, and the order with which the larynx is most frequently affected is as follows:—

1. The arytenoids.
2. The interarytenoid region.
3. The vocal cords.
4. The ventricular bands.
5. The epiglottis.

Amongst early symptoms, a striking one is anæmia of the

palate and larynx. Occasionally there are patches of hyperæmia, catarrh, congestion, paresis or adduction, or even functional aphonia. In slightly more marked cases, we get tuberculous deposit, erosions, and ulcerations. The arytenoids and the epiglottis may become swollen with a pseudo-œdema. The vocal cords seldom show much infiltration, as this soon breaks down into a mouse-nibbled ulceration. In more advanced cases, we get the turban-shaped epiglottitis, stenosis of the glottis, perichondritis of the cartilages, with intercurrent attacks of œdema and abscess. More rarely, the disease appears as a more localized tuberculoma.

DIAGNOSIS.

In many cases, the skilled eye can at once settle the diagnosis from the appearances, the situation, and the local changes, but in all cases confirmatory evidence should be sought in the sputum, the chest, and the state of the pulse, temperature, and so forth. In difficult cases, test injections of tuberculin may be required, and in others, simple laryngitis, pachydermia, malignant disease, and syphilis must be eliminated, not forgetting that the latter may co-exist in many cases.

PROGNOSIS.

In 1880, Morell Mackenzie stated that "the prognosis of laryngeal phthisis is always extremely unfavourable, and it is not certain that any cases ever recover." Complete and lasting cures are nowadays obtained in a fair number of cases, but in a large number, when the laryngeal disease is widespread and the pulmonary disease is extensive, the outlook is not hopeful, and it is rendered much worse if we meet with rapid pulse, persistent elevation of temperature, anorexia, dysphagia, loss of weight, want of moral vigour, pregnancy, or a bad family history.

TREATMENT.

The first and most important principle is to treat the patient and his pulmonary tuberculosis; the second is, if possible, to cure the larynx; and the third, in all instances, is to relieve symptoms. Each case may be viewed as one of pulmonary origin with laryngeal extension. The principles

of sanatorium treatment—diet, rest, exercise, open air, and regular medical supervision—must always be insisted upon. Tobacco and alcohol should be abandoned, and in early cases, particularly when the vocal cords are affected, strict silence should be enforced. Under this treatment many cases of early laryngeal disease will heal spontaneously, and without any local treatment at all.

Before the days of the open window, the tuberculous larynx had to be kept fairly clean with antiseptics. Only those who remember that time, and who now have an opportunity of seeing sanatorium work, can realize the benefit to the larynx of life in unvitiated air. When this is not possible, laryngeal catarrh may be relieved by the use of cleansing alkaline sprays, followed by a spray of liquid vaseline containing menthol (10 to 20 grains to the ounce), chloretone, and antiseptic oils. Local cough and irritation will nearly always cease with general care and hygiene, but simple lozenges of glycerine, carbolic, menthol, liquorice, or lemon may be used. Those containing heroin (gr. $\frac{1}{12}$), codeia (gr. $\frac{1}{8}$ – $\frac{1}{4}$), morphia (gr. $\frac{1}{40}$ – $\frac{1}{12}$), or cocaine (gr. $\frac{1}{10}$) may be employed.

With dysphagia, the food should be soft and well masticated. The pain of deglutition can sometimes be relieved by getting an assistant to stand behind the patient, and make firm and even pressure at the angle of each jaw at the moment of swallowing. Or Wolfenden's position may be adopted; the patient lies prone on a couch, with the face over the end, and sucks the nourishment through a glass tube from a cup on the floor. Relief to dysphagia may also be obtained by a laryngeal insufflation of 3–5 gr. of anæsthesin. If given an hour before the chief meal of the day, it may furnish 24 hours' comfort. It is only effective when there is ulceration. Pain may also be alleviated by injections of alcohol into the superior laryngeal nerve. Sprays of cocaine (2 per cent.), and insufflations of morphine (gr. $\frac{1}{16}$ – $\frac{1}{4}$ with gr. ii. of starch) should be reserved for hopeless cases.

Dyspnœa, from stenosis, will frequently subside with strict local and general rest. When stridor becomes marked, interfering with sleep, rest, or circulation, a median tracheotomy is carried out under local anæsthesia. Local infection of the tracheotomy wound is a complication to be feared in

progressive cases. Perichondritis and tubercular abscesses in the neck are, of course, opened from the outside.

Sprays, insufflations, and inhalations may all help to check local catarrh and cleanse local suppuration, but all this armament of local medication has been simplified greatly since sanatorium principles and voice rest have been adopted generally.

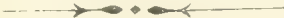
"Painting the larynx"—once the greatest weapon of laryngologists—has fallen into disuse, and many of those who once used lactic acid have now entirely abandoned it. At present, our most satisfactory weapon is the galvano-cautery. It has been shown to be a valuable method of cure in many expert hands, when employed in select cases in which the larynx and general criteria warrant local interference. The electrode, brought to a white heat, is thrust into the diseased area in several points, under cocaine anæsthesia. Several sittings at intervals of two to four weeks may be required, and a cure may require anything from 3 to 20 months. Curetting is also a local measure suitable for removing broken-down granulations or fungating areas.

Tracheotomy is not a curative measure, but may rarely be required in cases of extreme stenosis.

Finally, the coincidence of syphilis will call for treatment by mercury, iodides, and salvarsan.

Pregnancy must always be viewed with anxiety. It would generally contra-indicate active local treatment, but tracheotomy may be necessary. The induction of abortion or premature labour is not warranted, as the disease advances just as rapidly when the uterus is emptied as when the pregnancy is not interrupted. Pregnancy is to be avoided in cases of laryngeal tuberculosis, and nursing should be forbidden.

Treatment with tuberculin has not, in my experience, fulfilled the high hopes entertained of it in some quarters. A few cases are improved by it, in other cases the treatment has to be discontinued, and in the larger number of cases the effect is nil. But the method is being tested carefully and dispassionately in the Midhurst Sanatorium at present, and the results will be made known later on.



TUBERCULOUS DISEASE OF THE EAR.

BY WILLIAM MILLIGAN, M.D., M.S.

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TUBERCULOUS disease may attack the external, middle, or internal ear, and may be either a primary infection, or secondary to tuberculous lesions elsewhere, *e.g.*, lungs, bones, or joints.

Temporal bone tuberculosis, which is, as a rule, secondary to tuberculous disease of the mucous membrane lining the middle ear cleft, leads at times to tuberculous infection of the meninges and intracranial abscess. The intracranial infections secondary to tuberculosis of the petro-mastoid are more usually, however, of septic origin, the original monomicrobial infection becoming at an early stage a mixed or polymicrobial infection from the presence of such pyogenic organisms as streptococci, staphylococci, meningococci, &c.

EXTERNAL EAR.

Tuberculous disease of the external ear is seldom met with. It may appear in the form of superficial and shallow ulcerations, covered with a thin, sanious, and foetid secretion. Scrapings taken from such ulcers may show, although rarely, the presence of bacilli. A form of non-bacillary tuberculosis, lupus, is fairly frequent, however, and occurs clinically as lupus vulgaris, lupus hypertrophicus, and lupus erythematosus.

Primary lupus of the external ear is rare. As a rule, it spreads from adjoining structures, such as meatus, face, neck, &c. If allowed to run its course, great destruction of tissue followed by deformity results. Lupus nodules vary in size, extend deeply into the subcutaneous connective tissue, and of a pale pinkish colour. Between individual nodules or tubercles areas of healthy skin intervene. The nodules tend, however, to coalesce and form dense indurated areas, which may remain quiescent for long periods, or to break down and

form indolent ulcers. These ulcers have the peculiarity of frequently healing at one part while extending at another. Cicatricial contraction, with consequent deformity, is prone to occur.

Lupus vulgaris is the form most usually found attacking the external ear. It is met with, as a rule, in children and young adults, and especially among those living in ill-ventilated and insanitary houses. The isolated nodules tend to break down and form superficial ulcers, with indurated edges and moist surfaces. They exhibit a marked tendency to spread superficially. Histologically, the nodules consist of masses of granulomatous tissue, composed of lymphocytes interspersed with endothelial cells.

Lupus hypertrophicus is characterized by an excessive growth of granulation tissue, and thickening of the affected parts.

Lupus erythematosus shows a marked tendency to symmetry, and to attack the external surface of the auricle. It occurs either as a chronic and circumscribed, or acute and diffuse affection. When chronic, it may assume the "butterfly patch" appearance so frequently seen in the face. When acute, it shows much less tendency to be symmetrical, and simulates a local cellulitis or erysipelas. It responds much less readily to injections of tuberculin than *lupus vulgaris*, and is probably due to a tuberculo-toxin.

TREATMENT.

Each individual nodule or tubercle should be destroyed separately by puncture with a fine galvano-cautery point, or by injection with an ethereal solution of iodoform. Hebra's potassium-silver method of treatment is also efficacious. A local application of a 30 per cent. solution of caustic potash is first made, in order to destroy the indurated epithelium, followed by painting the raw surface so produced with a 25 per cent. solution of nitrate of silver. Strong solutions of iodine, lactic acid, chloride of zinc, pyrogallie acid, or salicylic acid are also useful in destroying isolated tubercles. X-ray treatment or Finsen's photo-therapy is now largely employed, and with success, more especially in the nodular and hypertrophic forms of the disease. When large areas of tissue are involved, injections of tuberculin have proved of

signal service.

Should ulceration have taken place, the infected area, after having been anæsthetized, should be scraped thoroughly with a sharp Volkmann's spoon, and acid nitrate or mercury rubbed into the bleeding surface, followed by an application of pure phenol. In severe cases, removal of a portion of the external ear may be necessary, the resulting defect subsequently being made good by a plastic operation, or by the wearing of an artificial ear.

Granulomata of tuberculous origin, the so-called tuberculomata, are found in both the external auditory meatus and the tympanic cavity. Histologically, marked activity of the meso-thelial elements of the part is found, lymphocytic infiltration being ultimately replaced by fibrous tissue, and dense non-vascular tubercles formed. As the result of fusion of meso-thelial cells, giant cell-systems, which have a marked tendency to caseate, are produced. Bacilli are however rarely found. Lupus granulomata differ from tuberculomata in showing less tendency to caseate, and in a greater tendency to sclerotic infiltration. Bacilli have, so far, not been discovered.

MIDDLE EAR.

Tuberculous disease of the mucous membrane lining the middle ear cleft, or of the temporal bone, occurs in practice either as a primary or secondary infection. *Primary tuberculosis* is most frequently met with in infants and children under five years of age. It is especially prone to attack the cancellous tissue of the petro-mastoid and the mucosa lining the tympanic or mastoid cavities.

The principal channels along which bacilli travel to reach the middle ear or the structures in its immediate neighbourhood are:—(1) Aerial; (2) lymphatic; (3) vascular; and (4) along collections of lymphoid tissue around the Eustachian tube.

Primary infection in early life is favoured from the fact that the Eustachian tube is shorter and wider than in the adult, and also because its tympanic ostium occupies a lower level in relation to the floor of the middle ear than in the adult. Moreover, the pharyngeal orifice of the tube is situated nearer to the corresponding choana and oral cavity than in the adult, with the result that infection is more likely to take place

from such acts as vomiting, retching, sucking, &c. N. Raw considers, however, that infection by way of the lymphatic stream is more common than even ærial infection, and maintains that the feeding of children upon milk from tuberculous cows is the most frequent cause. Against this theory there is, however, the fact that the majority of infants are breast-fed. Of twelve cases observed by P. Matthews, six had a family history of tuberculosis, and in five under one year of age, three had been breast-fed before admission to hospital, while one had been reared upon a patent food.

Secondary infection of the middle ear cleft is most frequently met with amongst those suffering from advanced pulmonary phthisis—the stage of cavitation—tuberculous disease of the larynx, pharynx, bones, joints, glands, and naso-pharyngeal adenoids. Its frequent occurrence in the last stages of pulmonary phthisis is due to the fact that the patient, enfeebled from disease, is unable to get rid of expectoration, which, therefore, tends to gravitate into the post-nasal space, and consequently to infect the Eustachian mucosa. In addition, in such advanced cases, the adipose tissue around the tubes becomes shrunken, and the lumen increased from lack of support, with the result that infected secretions more readily reach the cavum tympani.

PATHOLOGY.

The essential feature of a tuberculous lesion—whether of mucous membrane or of bone—is multiplication of epithelioid cells (endothelial and perithelial), which eventually replace the normal elements of the structure. These collections of epithelioid cells or tubercles, having no power of forming blood vessels, die and caseate. Surrounding each focus is a widely spreading zone of lymphocytes, which tend to wander among the normal elements of the part attacked. Numerous giant-cell systems are also found amongst these epithelioid masses without, as a rule, bacilli being present. Under such conditions, the morbid process is usually slow and asthenic. When, however, giant-cell systems are few in number, and bacilli numerous, the process is acute. Osteoblasts, which, as a rule, are numerous in septic processes, are rarely found in tuberculous lesions, their work being apparently performed by modified endothelial

elements.

Symptoms are both general and local. The various general symptoms met with depend to a large extent upon the organ or organs involved, upon the degree of constitutional disturbance, and upon the presence or absence of toxæmia. In many cases, rapid inanition, night sweats, diarrhœa, and general prostration are present. Erythematous or hæmorrhagic rashes are observed at times, the latter being due to some hæmic disturbance, the result of an existing tuberculo-toxæmia. In uncomplicated cases, the temperature is, as a rule, atypical. When, however, several caseating tuberculous foci are scattered over the body it assumes the "hectic" type. Complications such as meningitis, sinus thrombosis, brain abscess, etc., cause marked variations.

LOCAL.

In exceptional cases, the onset of the disease is acute, and the symptoms those of an ordinary acute otitis media. The want of reaction, the presence of two or more perforations of the membrana tympani, the enlargement of the periauricular glands, and the frequent and early appearance of facial paresis or paralysis serve, as a rule, to indicate the true nature of the underlying pathological process.

Much more usually, however, the course of the disease is asthenic from the commencement, being marked by an almost complete absence of pain, and by the appearance of one or more perforations with faintly vascular edges. Should there be, however, a coincidental pyogenic infection, severe pain may be complained of. When perforation has taken place, the membrane appears slightly congested, but there is an entire absence of that inflammatory reaction invariably met with in cases of phlogogenic origin. In many cases, two or more perforations are present; coalescence of the edges of these perforations may take place, with consequent almost complete destruction of the membrana tympani.

When, however, the disease runs, as is usual, an asthenic and painless course, the membrana tympani appears pale, flabby, and œdematous, and the edges of the perforation grey, inactive, and flabby. The cavity of the middle ear is frequently found full of pale granulomatous tissue, which, on histological exami-

nation, shews the characteristic appearances of tuberculous degeneration. The resulting discharge from the middle ear is fairly copious, thin, and sanious. Moreover, it is generally foetid either from secondary infection with putrefactive organisms, or because its source is from diseased bone.

Early and extensive implication of bone—with or without the presence of osteo-myelitis—is common, ending at times in almost complete destruction of the cancellous tissue of the petro-mastoid. Necrosis with consequent formation of sequestra, consisting of the outer attic wall, portions of the cochlea, or semi-circular canals, due to a superadded pyogenic infection, is by no means uncommon.

Cario-necrosis of the ossicula auditus is also frequent. In many cases, tuberculous osteomyelitis attacks the pars mastoidea with destruction not only of its cancellous tissue, but also of its cortex, with consequent formation of a subperiosteal abscess, which on being opened is found to contain a putty-like material and débris.

The frequency with which tuberculosis attacks the temporal bone explains the occurrence of facial paralysis. In tuberculous middle ear disease, facial paralysis is found in about 65 per cent. of the cases, whereas in pyogenic otitis media it occurs only in from two to three per cent.

Enlargement of the periauricular glands is an early and common symptom. The glands first affected are the parotid, mastoid, and retro-pharyngeal, followed later on by infection of the deep cervical. At times, glandular enlargement is present before rupture of the membrana tympani has taken place, and before the advent of facial paralysis. These enlarged glands may ultimately become matted together by recurring attacks of periadenitis of septic origin.

In secondary tuberculosis of the middle ear, glandular enlargement is not common, except in those cases in which there is a superadded and severe pyogenic infection of the mucous membrane of the middle ear cleft.

INTERNAL EAR.

Tuberculosis of the internal ear is, as a rule, secondary to tuberculosis of the middle ear cleft, although primary tuberculous deposits in the pars petrosa are not uncommon. The

usual paths of infection are by way of the fenestræ, more especially the fenestra ovalis. At an early stage the static and acoustic segments of the internal ear are affected, but the insidiousness of the process prevents the development of symptoms of the Menière type.

DIAGNOSIS.

The diagnosis of aural tuberculosis is not by any means easily made. Certain clinical signs and symptoms, such as the painless origin of discharge, the early appearance of facial paralysis, enlarged periauricular glands, and the presence of two or more perforations are certainly suggestive but not confirmatory. To clinch the diagnosis, search should be made for the tubercle bacillus either in discharge from the middle ear, in tufts of exuberant granulation tissue, or in pieces of bone removed from the advancing edge of disease. The bacillus is, however, admittedly difficult to find. The most exact method of demonstrating the actual nature of the disease is the inoculation of guinea pigs with fragments of bone or of granulation tissue. Should the lesion be tuberculous, tuberculosis will rapidly develop in the inoculated animal. Such tests as von Pirquet's cuti-reaction, Calmette's ophthalmic reaction, and inunction with Morro's tuberculin ointment are only of value, if clinical evidence negatives the existence of tuberculosis in other organs of the body. Under such circumstances, a positive reaction would be in favour of the aural lesion being of tuberculous origin.

PROGNOSIS.

A guarded prognosis should always be given. In infants, the mortality is high, from 40-50 per cent. of the cases proving fatal. In young children, when the disease is primary the prognosis is distinctly more favourable, as surgical measures combined with fresh air, good food, and tonics will frequently serve to arrest the disease. In secondary cases, the prognosis must necessarily be grave, especially when the original lesion is of pulmonary origin.

TREATMENT.

From the therapeutic point of view cases should be

divided into two main classes :—

1. *The inoperable.*
2. *The operable.*

To the former, belong those cases occurring in enfeebled infants in whom large masses of glands exist around the ear, facial paralysis is present, and there is a copious blood-stained and foetid discharge.

Cases suitable for operation are those in which the general health is apparently fairly good, the disease primary, and its extent not beyond the limits of surgical intervention. In cases of secondary origin, in which there is reason to believe that removal of the diseased portions of the temporal bone would exert a favourable influence upon tuberculosis elsewhere, as in the lungs, joints, &c., operation is not contra-indicated. It is advisable in infants and young children with lowered vitality to operate by *stages*. In general, no typical operation should be attempted, the indication being to remove, so far as is possible, all infected bone and to secure free drainage.

The judicious employment of tuberculin favours healing, and, in the writer's hands, has proved of distinct value. In addition to local treatment, surgical and otherwise, fresh air, good food, tonics, and cod-liver oil are indicated.

The intracranial complications of tuberculous otitis media are (1) meningitis, (2) abscess. Tuberculous meningitis undoubtedly occurs as the direct result of tuberculous otitis media, although, in the writer's experience, the purulent form is distinctly the more common. Cases of true tuberculous intracranial abscess have been recorded from time to time, but it must be admitted that demonstration of the tubercle bacillus in chronic abscesses and in intracranial tuberculomata is exceedingly difficult, from the fact that, in all chronic cases of tuberculous otitis media, the infection becomes mixed and very largely pyogenic in nature.



THE EYE IN RELATION TO TUBERCULOSIS.

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It is impossible in an article of this length and purpose to give a tithe of the information available on this subject, but for the benefit of those who desire further enlightenment, I will give some references at the end to more detailed communications. Some of the lesions produced by tubercle in the eye would not have much interest for the general practitioner; on the other hand many will, and the object of this article is to enable the general practitioner to diagnose easily and accurately where possible, the common manifestations, and also to indicate the best line of treatment.

After a general consideration of our subject, it will be simpler if I describe in detail the symptoms and treatment of tubercle affecting the conjunctiva, iris and cornea, as these are the conditions of greatest practical importance; tubercle affecting the choroid, retina, and optic nerve being of more interest to the specialist.

Tubercle has been found invading all the tissues of the eye, the conjunctiva, cornea, sclera, iris, ciliary body, choroid, optic nerve and retina; the lens and vitreous are only involved secondarily. Not only the eye itself, but also the tissues surrounding the globe may be affected, and I have notes of four cases in which large masses have appeared in the orbit, pushing aside the eyeball and presenting all the clinical signs of primary growth, but which, on microscopic examination, proved to be tuberculous. One of these cases I published, with my colleague, Dr. Eyre, in the *Ophthalmological Society's Transactions*, and it is fully recorded there; the other three are probably cases of tubercular periostitis of the orbit, but one of them was undoubtedly due to extension of tubercular mischief from the ethmoidal cells into the orbit. All four cases recovered under treatment.

There has been, I think, far too much stress laid upon what is called the tuberculous appearance of the patient. We are too expectant of finding a definite history of tuber-

culous affections in the patient's family, or of seeing evidence of the "pretty struma" with peach-blossom complexion and a frail, delicate physique, or else of the "ugly struma" with thickened lips, *alæ nasi*, and skin, and enlarged lymphatic glands. In my experience, the majority of patients who have had proved tuberculous lesions of the eye, have been robust, healthy-looking people, whose appearance absolutely belied any suspicion of their malady.

Tubercle affects the ocular tissues much oftener than was formerly supposed; our attention has been drawn to this fact by the elaboration of numerous new tests for tubercle, and numbers of ophthalmic cases in which the ætiology was obscure, have shown definite reaction to Koch's, Calmette's or Von Pirquet's tests.

THE CONJUNCTIVA.

Tuberculosis of the conjunctiva is an infective granuloma affecting the conjunctival tissues, either bulbar or palpebral; it is due to the local multiplication of the bacillus tuberculosis, and to the action of the toxins it elaborates. Histologically, its basis is the giant cell system, although in some instances the surrounding hyperæmic granulation tissue completely masks the fundamental "tubercle." Tubercle of the conjunctiva most commonly presents itself as an extensive ulceration involving the fornix and palpebral conjunctiva; in the early stages miliary tubercles may be seen, but these soon break down, run together and form a conglomerate mass, partially ulcerated, with out-lying tubercles, thickened oedematous areas, and hypertrophic granulations. An ulcer of this description, hidden as it is in the loose folds of the conjunctiva, may only draw attention to its existence by a slight fullness of the lid with watering of the eyes; when the upper lid is involved, ptosis is usually noticed.

The preauricular gland is involved early, so that the patient, when looked at from the front, displays a puffy swollen lid with a swelling in front of the tragus. Attention having been drawn to the lids, the mass, if of any size, can be felt through the skin, but the patient complains of little beyond watering of the eye, and one is often surprised at the extent of the ulceration and the insensitiveness of

the conjunctiva. After the involvement of the preauricular gland, the glands superficial to the parotid enlarge, and later the glands at the angle of the jaw; suppuration may take place in these glands as the chronic ulcer is always secondarily infected by various pyogenic organisms, which easily effect lodgment in an inflamed conjunctiva.

Tuberculous ulceration of the conjunctiva is more frequently found in young people and at about puberty; when it occurs later, it may be mistaken for syphilitic ulceration, but the brawny dusky cedema and rapid reaction to antisymphilitic remedies simplifies the diagnosis. Tuberculous conjunctivitis generally affects one eye only, and a spontaneous cure is not to be looked for, since the ulcer becomes easily infected with various pyogenic organisms, and like tuberculous sinuses, the chronicity of the ulceration is due to the secondary infection rather than to the primary. The eye itself is seldom invaded until late in the disease.

An absolute diagnosis of tuberculosis of the conjunctiva can only be made from a bacteriological examination and the finding of the tubercle bacillus, but our suspicions should be aroused if we find an ulcer having an irregular and ragged margin, watery granulations at its base, and outlying grey "tubercles" around. The diagnosis would be still more certain if there should be a thin discharge, undermined edges, and hypertrophic granulations. The hypertrophied masses are due to caseous material which has not yet broken down. The discharge may become muco-purulent and thick when necrosis takes place, and the ulcer is contaminated by various pyogenic organisms, but is usually thin and scanty.

A case of tuberculosis of the conjunctiva will be found fully described and illustrated in the *Ophthalmological Society's Transactions*, Vol. 28, 1908, and Dr. Eyre has dealt fully with this subject in the *Hunterian Lecture*, 1912. He describes five clinical types:—(1) Ulceration, (2) miliary tubercle, (3) hypertrophic granulation, (4) lupus, (5) pedunculated tumour. The first three, however, generally appear in the same lesion; the fourth is an extension of the lupus present on the face and would not lead to any difficulty in diagnosis on that account, and the pedunculated tumour would suggest removal, its histological character alone indicating its aetiology.

Phlyctenular conjunctivitis is not tuberculous, the bacillus never having been demonstrated in the lesion, but it is an indication that tubercle is present somewhere in the body. Phlyctens have been produced experimentally by the injection of tubercle toxins, also as the result of Calmette's reaction, and are due probably to tuberculous toxæmia rather than to the presence of the bacillus itself.

Eyre gives the proportion of cases of tuberculous conjunctivitis among ophthalmic cases as 1-2,500.

The diagnosis can be supported by many and various methods:—(1) The clinical appearance of the lesion; (2) Calmette, Von Pirquet, and Koch's tests; (3) the opsonic index; (4) histological, bacteriological, and inoculation tests. The only absolute proof of the ætiological factor, however, is the demonstration of the existence of the tubercle bacillus in the tissues. It is probable that most cases of tuberculous conjunctivitis are due to direct inoculation of the conjunctiva with tuberculous material, and are not endogenous infections, since the blood stream is more likely to convey the poison to the interior of the eye, or the skin of the lids, rather than to the conjunctiva itself. The conjunctiva may be invaded by the bovine or human form of bacillus. In the present state of our knowledge, however, we cannot differentiate clinically which form is present; the bacteriologist can help us, and if a definitely tuberculous ulcer does not react to human tuberculin, the bovine should be tried.

THE IRIS AND CILIARY BODY.

A chronic iritis with few inflammatory symptoms and without any obvious ætiological factor, such as syphilis, gonorrhœa, or kidney trouble, should always arouse suspicion of tubercle as a possible cause. When the iris presents a typical clinical picture with characteristic features of tubercle, the appropriate treatment can be started at once, but often it is impossible to make a positive diagnosis until one of the diagnostic tests has been carried out. A typical case of tuberculous iritis shows the presence of "tubercles" in the iris tissue; they are generally on its anterior surface, near the pupillary or peripheral margin, and rise towards the posterior surface of the cornea. If the "tubercle" is sufficiently high it touches

the posterior part of the cornea, and at the point of contact this turns opaque; an interstitial haze develops, due to the toxic irritation of the corneal tissue. These "tubercles" and opaque corneal areas are mainly found at the periphery of the cornea, but the opacities may develop anywhere, independently of contact with the "tubercle." At the same time a number of posterior synechiæ will be present, these being firm, moderately wide, blunt-ended adhesions, which show no disposition to yield to the action of atropine.

These three clinical appearances, grey "tubercles" on the surface of the iris, discrete corneal opacities, and broad flat synechiæ, form the typical clinical picture, but tubercle has other forms in which it attacks the iris. A large solitary mass at the angle of the anterior chamber may involve the sclera, and produce an ectasia at the ciliary region, which may perforate, or the whole anterior chamber may be filled with tuberculous material. Another form, which is less certainly tuberculous, is the "mutton-fat" deposit in the anterior chamber. I have not often been able to prove satisfactorily that tubercle was the ætiological factor in these cases, but they are held to be tuberculous by many competent observers.

It is unnecessary, I think, to complicate the description of tuberculous affections of the ocular tissues by describing numerous clinical varieties, since these groups when analysed only depend on the fact that the smallest and earliest lesion is the miliary "tubercle," and if these are numerous and close together, a single large mass is formed instead of a number of small ones; also a large conglomerate mass may have some small single "tubercles" on its periphery; this is so in the conjunctiva, the iris, and choroid. Tubercle does not produce an acute iritis in the same way that syphilis or gonorrhea will; that is to say, an iritis which comes to an intense condition in two or three days, with the episcleral and conjunctival vessels all involved, much pain, photophobia, lachrymation, and rapid, serious failure of vision. Tuberculous irido-cyclitis is usually chronic, with slight redness of the eye, slight watering and photophobia, and slight pain.

There is often some keratitis punctata, *i.e.*, little grey or brown dots scattered over the posterior surface of the cornea, the larger and more numerous ones being at the lower part,

and if small are only seen with a magnifying glass; when however, the "mutton fat" variety is present, the mass can be seen with the naked eye. These dots are, according to Straub, the result of chemio-tactic action resulting from toxins having destroyed the endothelial cells lining the anterior chamber, and the mononuclear leucocytes being attracted in order to resist the invasion and remove the débris.

Tuberculous iritis may heal spontaneously, but on the other hand the interstitial opacities in the cornea often produce serious interference with vision, and if the inflammation spreads backwards and involves the ciliary body, the whole eye may shrink and phthisis bulbi result.

Tubercle may attack the ciliary body either before or at the same time as the iris. When the ciliary body is involved, the interference with sight is more marked, as the ciliary muscle is affected in the early stage, and later vitreous opacities form. The sclerotic in the ciliary region is often invaded in those cases in which the ciliary body is attacked and a sclero-keratitis with localized ciliary congestion and ciliary staphyloma may result; this, however, is much rarer now that the disease is becoming recognized earlier, and tuberculin treatment undertaken systematically.

THE CHOROID.

That tubercle affects the choroid has been known for many years, as "tubercles" in association with tuberculous meningitis were described long ago by Cohnheim, and have frequently been recorded since. It was, however, looked upon as of rare occurrence and of no very practical utility, since these cases were considered to be beyond medical help, and the discovery was accepted as substantiating the diagnosis, without in any way improving the prognosis.

Lately, however, great prominence has been given to this question by the observation of many surgeons that, in cases of choroiditis of doubtful origin, the laboratory tests with tuberculin often show positive reactions, and in the absence of any other certain ætiological factor, treatment with tuberculin has been carried out with, in some cases, considerable success.

Tubercle attacks the retina and choroid mainly in the region of the macula and optic nerve head. In the acute

stage, the retina is markedly œdematous, and consequently the lesion in the choroid is difficult to focus with the ophthalmoscope, but in the centre of the œdematous area, a soft white spot, about the size of half of the optic disc, can often be seen, having ill-defined margins and no pigment; this becomes more distinct and clearly circumscribed as the case goes on, and one or several may be present. If the patient is running a temperature and symptoms of meningitis set in, the diagnosis of tuberculous meningitis is made absolute. On the other hand, acute tuberculous inflammation of the choroid may be present in an apparently healthy individual, and is sometimes seen in the out-patient department. It is characteristic of these cases that they heal spontaneously, but generally destroy the choroid in its immediate neighbourhood, leaving a patch of choroidal atrophy of circular shape and varying size.

There may be many patches, so that a case of disseminated choroidal atrophy may turn out to be due to tubercle, whereas some few years ago disseminated choroiditis was looked upon as being pathognomonic of a syphilitic taint. The patches of tuberculous origin are not usually as much pigmented as those due to syphilis, and show more evidence of fibrous tissue formations; it is not always possible to differentiate between the two forms clinically. A suggestion has been made that the large solitary patches of choroidal atrophy seen in the macula region in one eye, and usually thought to have been congenital gaps in the choroid (coloboma of macula) are really solitary tuberculous foci, which have become obsolescent; if this is correct, it explains those cases of cyclopia which are not infrequently found in the out-patient department, and in which the patient is surprised to be told that he can see only with one eye, the surgeon having discovered a large central single patch of choroidal atrophy present at the macula. The onset of this condition is quite unrecognized by the patient, and as it probably occurs very early in life, the acute stage is not usually seen, or at any rate not recorded. The diagnosis depends on the observation that the patient reacts to the tuberculin test, and also on the clinical similarity of the patch of choroidal atrophy with those patches which result from known cases of tuberculous choroiditis.

I have at present under my care, a case in which a large

smooth, round mass can be seen coming forward from the posterior pole of the eye and covered by the retina ; it is three or four millimetres high, and has been watched for over three years without any marked alteration and any definite local or general symptoms developing. When, however, I had the opportunity of admitting this patient into Guy's Hospital and investigating the condition, I found that, after injecting .001 c.c. of Koch's old tuberculin, the patient had a rise of temperature to 103° . In the entire absence of any other ætiological factor, and taking into account the length of the history, it is probable that it is a mass of conglomerate tubercle ; other similar cases have been recorded.

It will be obvious, therefore, that much of our knowledge of tubercle, as an ætiological factor in causing choroidal atrophy and chronic choroiditis, has only recently been acquired, and is still inconclusive ; the next few years, however, will certainly establish the relative frequency of its occurrence, and this will be a matter of considerable advantage in treating this class of case.

It is doubtful if tubercle bacilli invade the cornea primarily ; I have not seen a case, and it must be rare, but parenchymatous infiltration is seen in association with tubercle of the iris and ciliary body, and also as the result of the toxins elaborated within the eye, in cases in which the optic nerve or choroid is involved. Tuberculous keratitis is characterized by its denseness, whiteness and patchiness. The whole cornea is never involved, only small islands of opacity occur, generally at the periphery, near to or actually touching the scleral edge. They are whiter than the syphilitic variety, and the cornea around is generally perfectly clear, the affected area being circumscribed and never diffuse. Several patches of varying intensity may be present or sometimes only one. These opacities clear spontaneously, and it is probable that the bacillus itself is seldom or never present, but that the change is due to tubercle toxin, since ulceration seldom occurs and, if the patient's general health improves, they slowly disappear leaving no scar at all.

Histologically, the lesion presents only small-celled infiltration, and not the typical tubercle systems. Frequently phlyctens are present in the same case, and there is little doubt

that the ætiology is similar in both conditions, and that many cases of corneal ulceration, phlyctenular ulceration, superficial keratitis, etc., occurring in strumous children, may have, as their primary cause, an irritation due to the presence of tubercle toxins, and that secondary invasion by pyogenic organisms masks the primary factor; when bacteriological examination is made, the more easily growing and active pyogenic organisms are usually found, and are accepted as the original cause. These areas of interstitial keratitis due to tubercle are most typical when seen in association with tuberculous irido-cyclitis, but areas clinically indistinguishable from these may exist apart from any involvement of iris or ciliary body.

The *lens* is only involved secondarily to changes in the ciliary body and iris, and is never the primary seat of tuberculous infection.

The *retina* is more often involved secondarily to tubercle of the choroid. Tuberculous retinitis may be, in the acute stage, indistinguishable, clinically, from tubercle of the choroid, as when the deep part of the retina is involved, the nerve fibre layer and retinal vessels still remain in front of the swelling and appear to be displaced forwards, and there is the same white swelling with œdema present in both conditions.

In tuberculous meningitis, "tubercles" may be deposited in the pial sheath and produce an optic neuritis, and, if they coalesce, may give rise to symptoms similar to those seen in cases of tumour of the optic nerve. I have recently had a case of tubercle of the choroid occurring so close to the nerve head, that when first seen, a diagnosis of papillitis was made, until further examination revealed the presence of keratitis punctata, and its exact nature was established. As both tubercle of the choroid and retina are commoner near the optic nerve head, the nerve itself may be involved secondarily by either of these conditions.

LACHRYMAL SAC AND DUCT.

It is possible that the lachrymal sac may be the site of a primary tuberculous invasion, but that is a rare occurrence. A chronic dacryo-cystitis is more commonly the result of a tuberculous infection of the nasal mucous membrane or the

conjunctiva, than due to primary infection. It must, however, be remembered, that, as Axenfeld points out, the dacryo-cystitis in a nasal or conjunctival tuberculosis is not necessarily tuberculous, but may be a simple inflammation due to the retention of the secretions, as a result of an obstruction to the duct. Clinically, these cases are characterized by their great chronicity, the formation of a lachrymal fistula, with caries of the bony wall surrounding the duct, and ulceration of skin around the orifice of the fistula. Few, if any, of these cases remain distinctly tuberculous, as all become infected with pyogenic organisms sooner or later, and the purely tuberculous appearance is masked by the infective process.

In the early stages, when the only symptoms are epiphora and a swelling over the region of the sac, the diagnosis must be made by an examination of the watery, muco-purulent discharge, and if the walls of the sac are thickened and lined by tuberculous material, it will be impossible completely to evacuate the swelling, but a distinct fulness will remain even after the contents have been squeezed out. This, of course, does not prove its tuberculous nature, but merely suggests that means should be taken to investigate the case from this standpoint, and if other means fail, it is advisable to incise the swelling, remove some of the thickened mucous membrane (for insertion into a guinea pig), sewing up the incision, in order to avoid, at all costs, the formation of a tuberculous fistula, which would probably become infected by pyogenic organisms, and then be much more difficult to treat.

The infection of the eye by tubercle is not always endogenous, but is sometimes exogenous, many cases being recorded of direct infection resulting from perforating wounds; the nature of the infection manifests itself by the occurrence of "tubercles" on the iris in some cases, and by a prolonged chronic inflammation resulting in an atrophy of the globe in others. From these sources of infection the whole body may become invaded, and general tuberculosis result. They are, in fact, much more likely to result in a general infection than are those cases where the uveal tract is invaded endogenously.

One of the numerous clinical methods used for diagnosing tuberculous lesions is an ophthalmic reaction, viz., Calmette's. In this test, a drop of a 1 per cent. solution of glycerine-free,

old tuberculin is dropped into a sound healthy conjunctival sac, in a patient suspected of having a tuberculous focus; in the course of 24 hours a distinct conjunctivitis supervenes in that eye. It is not, however, of so much use in ophthalmic work, as any ocular lesion contra-indicates its use, and if one eye only is affected it is better to use some other test rather than run the risk of inflaming the good eye. The test I find most reliable is Koch's subcutaneous test.

TREATMENT.

A large number of tuberculous lesions in the eye heal spontaneously. The tubercle bacillus provokes resistance (as indeed many other micro-organisms do also), and is the cause of various anti-bodies being elaborated in the blood, by means of which the cure is often brought about; this explains to some extent, the reason why in many of these conditions the ætiology has remained obscure. On the other hand, some lesions show no tendency to progress to such a desirable end, and very energetic treatment should be maintained.

In ocular tuberculosis, general treatment is of the greatest importance. It must not be forgotten that the tubercle bacilli are killed by direct sunlight in about five minutes; fresh air, plenty of food, fats, cod-liver oil, etc., and the general principles which have been indicated fully in other articles in this special number of *THE PRACTITIONER*, should be used in conjunction with the particular treatment indicated for the different tissues.

The large tuberculous ulcers of the conjunctiva should be kept as clean as possible and free from infection by pyogenic organisms. The conjunctival sac should be washed out thoroughly three or four times a day with iodine water, the surface of the ulcer gently scraped, so as to remove the soft necrosed tissues, and iodoform powder dusted over the surface. If the præauricular gland or the supra-parotid glands are softening, and show a tendency to "point," they should be opened, under strict anti-septic precautions, scraped out, the cavity thoroughly washed with iodoform emulsion, and the incision sewn up again. Tuberculin should be used, an injection of .0002 m.g. given every 10 to 14 days; the temperature must be taken every morning and evening for two days after each

injection, and if no rise takes place, the dose may be increased on the next occasion; if the temperature should rise, the dose must be diminished. The surgeon should carefully study the reaction of the patient to each dose, noting symptoms of malaise, pain, or fever or any exacerbations of the symptoms, and if these should occur, they must be taken as a caution not to increase the dose, or even, it may be, as an indication to diminish the frequency of it, or to cease the treatment entirely for a time.

A large ulcerated surface of the conjunctiva or a patch of lupus will often show marked improvement under the Finsen Light, and many people have recorded their appreciation of its value in these cases. Guaiacol has been extolled by Abadie and others in cases of tuberculosis, and he recommends sub-conjunctival injections, but I have not been impressed by the value of sub-conjunctival injections, but rather disappointed in my results when I have used them. In former times, these large tuberculous ulcers were vigorously scraped, or excised entirely or in part, but this treatment invariably led to severe cicatricial contraction and distortion of the lids, the remedy resulting in a very serious disfigurement. In all my recent cases, I have avoided this method and relied on general treatment, anti-sepsis, and tuberculin with very satisfactory results. Dr. Eyre has three of my cases in his list of 29 cases, and all these did well, as well as some others not included in that list.

Tuberculous iritis is very chronic, and treatment must be carried out for a long time, in some cases even as long as one or two years. Atropine solution (4 grs. to $\bar{3}$ i) should be used during the sub-acute stages, and the eye should be kept bandaged; general treatment and the hygiene suitable to tuberculosis should be carried out. In intractable cases the introduction of sterile iodoform into the anterior chamber has been advocated, and is certainly useful. The sub-conjunctival injection of one c.c. of a 1 per cent. solution of guaiacol is more useful in these cases of uveitis than in the conjunctival ones. Dionine, a morphia product and a lymphagogue, is of value in one, two or five per cent. solutions, in relieving deep-seated pain, and in stimulating the lymphatic circulation. When dropped into the conjunctival sac, it produces a tingling sensa-

tion and a rapid œdema of the conjunctiva, which however subsides uneventfully in a few hours.

In the opacities left by tuberculous keratitis and iridocyclitis, I have been very pleased with the improvement resulting from injections of sterilized air or oxygen under the conjunctiva. I usually use oxygen from an ordinary cylinder, connecting it with a generating flask, and from the flask by means of a small india-rubber tube, with a hypodermic needle at its end, I pass the gas under the cocainized conjunctiva, the flask obviates any too violent "blowing up" of the conjunctiva by the rapidly escaping gas.

Tuberculin should be used in all cases of tubercle affecting the eyes, but always in association with the general and local treatment also. With regard to surgical interference, before the advent of the tuberculin treatment, many surgeons maintained that intra-ocular tuberculosis necessitated the removal of the eye, in order to prevent a general dissemination; it is, however, unusual for intra-ocular tuberculosis to be primary, and general dissemination rarely happens; many cases happily resolve under treatment. If, however, the thorough carrying out of all treatment results in no lessening of the symptoms, whilst the patient's general health is suffering, and the condition is getting worse, excision of the globe is justifiable. A shrunken phthisical eye should also be removed, but the greatest care must be exercised to prevent a general dissemination of any tubercle bacilli present, which might occur by opening up the globe during the excision or cutting into any caseous masses present in the orbit.

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THE ASSOCIATIONS OF TUBERCULOSIS WITH DISORDERS OF THE NERVOUS SYSTEM.

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WHEN it was suggested by the Editor of THE PRACTITIONER that I should contribute an article on the associations of tuberculosis with disorders of the nervous system, I felt some reluctance in complying, because it appeared to me that, as compared with other aspects of the great tuberculosis question, there was not much to be said about it, at any rate by me. I would not, however, have it understood that I consider that the nervous system escapes well-nigh scot free in that general infective disease; but, I suggest, that many of the more obvious nervous derangements in tuberculosis are less the result of the toxic processes of tubercle or even of its direct destructive effects, than the result of mechanical pressure of the tuberculous products. As instances of this, I would mention some of the cases of tuberculous meningitis, or, more illustratively, the cases of solitary tubercle within the cranium or spinal canal, and the compression myelitis depending on tuberculous disease of the spine itself.

From what I have said, it will be gathered that I am prepared to divide the cases of tuberculous disease causing disorders of the nervous system into a larger group, in which the mechanical factor is predominant, and a smaller group, in which the toxic factor is the more important. But at the outset, I should like to emphasize the point that, in considering the subject, it is especially necessary to recollect that it is the patient and not the disease that really signifies.

The toxic effects, I would subdivide into those affecting the higher brain centres, manifested by certain well-recognized psychical changes of the nature of undue optimism or depression, or even by actual deprivation of consciousness; those

affecting the middle level centres manifested in certain rare cases by epileptiform or even tetanoid spasms; those affecting the lower or bulbar centres, manifested, I believe, by vasomotor changes and the early tachycardia and dyspnoea especially in the absence of pyrexia; those affecting the spinal cord, manifested, as I believe, as one of the causes by myoidema and rapid muscular wasting; and those affecting the nerves, manifested by the various changes in motor power, sensibility, and reflexes that are characteristic of the neuritis symptomatology.

The mechanical effects, to which I intend to allude, although I consider they are rarely purely mechanical, include those affecting the brain and cord in the form, as I have said, of meningitis and the tuberculous tumours, compression myelitis, and those forms of trunk neuritis due to pressure of an involvement of nerve trunk by tuberculous products or to a perineuritic fibrosis.

Considering first the more uncertain ground of the functional nervous disturbances, that are apparently due to a tuberculous toxæmia, it may be laid down as an axiom that the tuberculous patient is usually the subject of a neurasthenia of higher or lower grade. Having said this, it follows almost as a corollary that, in the early stages, at least, the psychological state is one of depression. It is, I suggest, chiefly in the later stages, when the toxæmia is more profound, when especially it is due to a mixed infection, and when there is a defective aeration of the blood, that the proverbial optimism, the *spes phthisica*, known to the man in the street, becomes prominent. In any case, it is certain that in the earlier stages of the disease the patient frequently manifests an uncomfortable change in disposition, he becomes irritable as well as depressed; a mother, it may be, becomes less interested in her children, and less affectionate towards her husband, or, what I have come to look upon as fairly characteristic at the beginning of the disease, the patient, heretofore a highly companionable person, develops a psychical atmosphere of "splendid isolation."

I am, of course, not now referring to the mental effect of such brusque accidents as a severe hæmoptysis. In these conditions, according to what is, I think, the general experi-

ence, there is, first, a short stage of terror, which eventually passes into a stoicism so pronounced as hardly to range itself within physiological limits. It is the psychical effect of the long continued minimal poisoning from the slowly developing tuberculous process that particularly concerns us now. The abrupt change following in susceptible persons, who are, however, really a majority of average persons, on an injection of tuberculin, constituting the "reaction," is indeed in itself largely a nervous phenomena. In those, moreover, who are of an unusually unstable nervous system, a rapid intensification of a previous neurasthenia may show itself with an exaggeration of the former headache, insomnia, and depression. Cases are not unknown in which an approximation to profound coma and even epileptiform convulsions have occurred. For example, in one case, in my own experience, symptoms similar to those of sunstroke persisted for a few days, and in another, after an injection of tuberculin, clonic spasm developed, both disappearing shortly, not to recur, while under observation at any rate.

Among the symptoms, which are apparently due to a toxic effect on the bulbar centres, the persistent tachycardia in the earlier stages before the onset of recognizable pyrexia may well be included; this symptom indeed, is held by some, among whom I rank myself, to have a considerable diagnostic value. Also the various vasomotor disturbances, such as the popularly recognized flushing on slight mental excitement, the coldness of the extremities, and the facile perspiration of the palms, and especially of the axillæ. For example, it is quite an ordinary experience, during the routine examination of the chest in phthisical patients, to see large drops of sweat rolling from the armpits. The pyrexia itself, in the earlier stages at least, may be grouped in the same category, and be taken to represent an accentuation of the normal diurnal variations, particularly of the normal evening rise in the presence of abnormally labile heat-generating centres.

In regard to the effects of the toxæmia on the cord centres, it is even more difficult to generalize, but I have myself come to consider that the irritability of the muscles of the chest-wall to direct percussion—the so-called myoidema—is an evidence of such. I have endeavoured to make out that there

was some correspondence between the myoidema of, say, one side of the chest-wall and disease of the lung on that side, so that one might have evidence of correspondence with such so-called spinal reflexes as the goose-skin and deep tenderness depending on disease of other viscera. So far, however, as the evidence goes, the myoidema would seem rather to be the expression of a general toxæmia.

Considering next the possible toxic effects of the tuberculous process on the peripheral nerves; cases have been met with in which there was localized muscular paralysis and atrophy, with changed electrical reactions, loss of sensibility, and abolition of the reflexes, that must be held to be parallel with the cases of peripheral neuritis from other toxic causes, such as alcohol, the toxins of diphtheria, enterica, influenza, diabetes, and so forth; but, so far as my own experience goes, I should say that such tuberculous cases were very much rarer than these, much rarer, for example, than the cases of influenzal multiple neuritis. At the same time, it may be suggested that in some of the cases, having regard to the well-known coincidence of alcoholism and tuberculosis, the inflammation of the nerve terminations may well be due to the combined effect of two toxins, thus comparable with the cases of retro-bulbar optic neuritis due to the conjoint influence of tobacco and alcohol.

Turning to the structural diseases of the nervous system due to tuberculous deposit, and considering first those of the brain, it is to be noted that, as far as present knowledge goes, the brain suffers in two ways from mechanical increase of pressure, as in brain tumour, and from inflammatory changes of the meninges and brain, the typical lesions being solitary tubercle on the one hand, and a meningo-encephalitis on the other. The solitary tubercle occurring in rounded masses has its more frequent seat in the lower parts of the brain, in particular in the cerebellum. Although it is called "solitary" tubercle, the tumours are frequently multiple in the same brain. Although usually deeply seated, they may be quite superficial, and not infrequently surrounded by a cystic formation; facts which have an important bearing on operative treatment.

The symptoms are those of intracranial tumour: head-

ache, vomiting, double optic neuritis, a slowly developing paralysis, and so on. As to treatment, great improvement, often amounting to practical recovery, is not unknown under hygienic measures with such conventional medicines as the syrup of the iodide of iron, and similar drugs. As to operation, the two clinical characters of multiplicity and deep-seatedness contra-indicate it; yet, in the presence of symptoms pointing to a cortical seat, and in the absence of evidence of more than one growth, operation would seem to be more than merely justifiable. I have myself seen a tuberculous tumour of the cortex resting in a cyst-formation, which at the necropsy nearly fell from the brain by its own weight. As compared with other brain tumours, the tuberculous growths have, in fact, a distinctly more hopeful outlook.

Tuberculous meningitis, on the other hand, has a future which is considered by the profession as being all but hopeless. Whether this view is altogether well deserved, I propose considering later, but at the best the outlook is so serious that any prophylactic measures against tubercle in general would be more than justifiable, if there were no ulterior risk other than that of tuberculous meningitis. It is nearly always secondary, and generally occurs in early life, when its seat is primarily the pia mater, towards the base of the brain, particularly in the neighbourhood of the Sylvian fissure; in later life, the convexity is more often the seat of election. It is important to remember in view of prognosis that the virulence of the infection is not the same in all cases, and in those in which the disease is localized and accompanied with little inflammatory change the condition is assuredly less desperate.

In some cases, the conditions threatening life seem to be in the main mechanical, and that from a great increase in intraventricular pressure—a flattening of the convolutions, as great in degree and far more widespread than in cerebral tumour, being a matter of everyday experience in the *post-mortem* room. In other instances a more or less extensive encephalitis makes a bad case worse. The classical course is usually described as divisible into fairly distinct stages; a prodromal stage, with moderate headache, photophobia, and perpetual vomiting, it may be, followed by a stage of cerebral excitement, with severe headache, the hydrocephalic cry, head

rolling, fever, and convulsive seizures; and lastly, the stage of coma, with paralysis of cranial nerves, individual limbs, or a slowly developing hemiplegia.

But such a dramatic and prolonged course is by no means without exception, as the following case that occurred some years ago in my own hospital practice will show. I may say that I mention it, not because I look back on it with any particular complacence, but because I think it illustrative. A boy, aged about 10, was brought by his mother to the out-patient department because of a sore throat. He walked into the out-patient room quite freely, did not look particularly ill, and gave the impression more of annoyance that his throat should be painful than of anything else. On examination, his throat was found to be injected, and possibly to have some superficial ulcerations. He was given what was considered appropriate treatment, the chief of which, as far as I remember, was some astringent antiseptic gargle. On the corresponding day in, I believe, the succeeding week the house-physician told me that the boy had died a day or two after his visit to the hospital, and that he, as medical officer to the institution, had been asked by the coroner to make a necropsy. On examining the head, he had found tuberculous meningitis, and had given it as his opinion that that was the cause of death. Whereupon, a sapient jurymen asked the house-physician, whether he considered that a gargle was the proper treatment for tuberculous meningitis?

The diagnosis of the disease should be made on the general signs of a meningitis, and on the result of a bacteriological examination of the cerebro-spinal fluid removed by lumbar puncture, that is, on the absence of other causal organism and the presence, which is usually to be made out, of the tubercle bacillus. The consideration of the question, whether there is any treatment of any possible avail in the condition, I will postpone for the present. Before passing to tubercle of the cord, I would, however, remark that a so-called serous meningitis is described without the occurrence of actual tubercles, which, in the absence of evidence to the contrary, may not unsafely be ascribed to the action of the tuberculous toxin, but this is a matter surely still *sub judice*.

In the cord, large solitary tuberculous masses may and

do occur, but how rarely it would be difficult to estimate, short of a very wide statistical research ; but at least this may be said, that they are of insignificant frequency as compared with gross tubercle within the cranium.

Among the more important diseases of the spinal cord and its membranes, associated with tuberculous disease, are the following : tuberculous tumours of the cord itself, already said to be very rare, or of the membranes ; miliary tubercle of the cord with or without conspicuous inflammatory change (myelitis) ; a meningitis, part and parcel of a tuberculous cerebro-spinal meningitis, with or without a superficial myelitis ; and, most important and frequent of all, the *pachymeningitis externa caseosa* associated with tuberculous caries of the spine. The last alone seems to need any detailed reference. The nervous disease, the result of this spinal disease, is usually termed a compression paraplegia. And so frequent is it, that the broad generalization may be made that, while an acute flaccid paralysis in children is probably an anterior poliomyelitis, a subacute spastic paraplegia is probably due to compression from spinal caries. The actual compression, however, may be due to different histological results of the tuberculosis of the spine, as a pachymeningitis, a tuberculous abscess, or even displaced bone itself.

Broadly stated, the main symptoms are the well-known localized pain in the back, with tenderness and muscular rigidity ; a spinal deformity, unless the caries be in the lumbar region ; root symptoms at the level of the lesion, such as pain, anæsthesia, and muscular atrophy, with reaction of degeneration in the wasted muscles ; and those cord symptoms below the level of the lesion that are characteristic of a lateral sclerosis, as paraplegia with rigidity, excess of the deep reflexes, ankle clonus, the extensor plantar response, sphincter paralysis, and so forth. Radiography may show the disappearance at one point of the clear areas due to the intervertebral discs, signifying the approximation of the bodies of the diseased vertebræ. The anæsthesia, it will be remembered, is mainly tactile ; if it involves sensibility to pain and temperature, there is usually a deeper injury to the cord in addition.

Tubercle affecting the cord in this way is, as we all know,

eminently curable. Recumbency and extension of the spine is usually sufficient to bring about the restitution of the suspended functions of the various physiological tracts of the cord. Still, in a considerable proportion of the cases a timeous laminectomy is, I believe, of great help in accelerating or completing recovery. Perhaps it is, as has been said, in those cases in which a rapid aggravation of symptoms has coincided with a manifest alteration in the position of the displaced bone, that operation is most called for, and especially helpful; but in a number of other cases, in which ordinary measures are not successful within a reasonable allowance of time, operation may be expected to obviate or lessen a permanent and perhaps a profound injury to the cord. It seems, however, to be the fact that, in the earlier stages and in the slighter cases, the abrogation of function is due rather to a compression œdema and lymph stasis than to an actual myelitis or sclerosis, and it is in this interval of time that operation has its especial value. The remote results to be dreaded, as leading to a fatal issue, are a severe and intractable cystitis resulting in suppurative pyelonephritis, paralysis of the respiratory muscles, and a total transverse myelitis.

In regard to the tuberculous affection of nerve fibre itself, I think that, for the sake of my argument, I may be permitted to claim that I have seen a fairly large number of cases of neuritis due to different pathological causes, that I have seen a fairly large number of cases of tubercle mainly of the lungs, and that I have for many years been on the watch for cases of neuritis having a probable tuberculous origin. Excluding such cases as neuritic pains down the arm, mostly on the affected side in phthisis, cases of sciatica, more numerous in institution cases than among the general population, and palsies of cranial nerves in tuberculous meningitis, the probable cases I have myself met with could be numbered on the fingers of one hand. I mean definite cases with pain, anæsthesia, motor paralysis, flaccidity and atrophy of muscles, and changed electrical reactions. Of course, many patients suffering from multiple neuritis have phthisis, but, in my experience, at any rate, in most there has been more or less clear evidence of the influence of another toxin, usually

alcohol, but not infrequently that of diabetes, so that, for myself, I would not allow more than a contributing influence to the tuberculosis factor in a large percentage of the cases.

In conclusion, I wish to refer to the question of the incurability or the curability of tuberculous meningitis. As a matter of common knowledge, a diagnosis of tuberculous meningitis has come to be considered as equivalent to a sentence of death. So much so has this been the case that, when in a case of supposed tuberculous meningitis recovery has occurred, the natural argument has followed that the diagnosis must have been erroneous. But this would seem to be hardly logical. Be that as it may, within recent times it has become possible to diagnose the disease with certainty, by a bacteriological examination of the cerebro-spinal fluid removed during the illness, and, as a result, we know that recovery does sometimes occur in undeniable cases, and that in other cases lengthy periods of improvement and quiescence may intervene before a fatal termination. But even before this exact diagnosis was in vogue, it was known that recovery in a number of cases did occur by finding post-mortem evidence of healed tubercle in the meninges.

What this exact method of diagnosis is, is well-known; the chief link, however, is the finding of tubercle bacilli in the cerebro-spinal fluid removed by lumbar puncture, which with general evidence of a cerebro-spinal meningitis, is held to be sufficient to clinch the diagnosis. The bacilli are, perhaps, most readily found by teasing the clot, that forms in the fluid after its removal, and staining the product in the approved fashion. As a fair representation of the availability of this test, I may allude to the cases examined by Bernstein, who thus found tubercle bacilli in 100 out of a series of 102 cases. If space permitted, I might give details of a substantial body of cases on record, in which the diagnosis was thus made sure, and in which recovery occurred.

Before alluding to some of them, I should like to mention the facts of what I believe to be an instance in point, that quite recently came under my own observation. A married woman, in the later months of pregnancy, had all the classical symptoms of tuberculous meningitis. A lumbar puncture was done, and the cerebro-spinal fluid was examined by an expert

pathologist. He reported that it contained tubercle bacilli in large numbers. The condition of the patient shortly became so desperate that, after consultation with an eminent gynaecologist, Cæsarian section was considered to be demanded by the circumstances of the case. It was performed, and a healthy child was removed alive. The mother made a complete recovery, the child it was that died.

What, one may ask not irrelevantly, is the cause of the frequent recovery from a tuberculous peritonitis after a simple laparotomy? It is due we are instructed to the lavage of the tuberculous tissues with a lymph rich in opsonins. May we not agree that the recovery in not a few unequivocal cases of tuberculous meningitis may have been due to a similar cause?

It must, however, still be admitted that, in the absence of this bacteriological evidence which we at present believe to be conclusive, it may be a wise scepticism that questions the diagnosis of tuberculous meningitis, for, as everybody knows, symptoms of "meningism," closely simulating the real thing, are frequently met with in the course of other illnesses; for example, during the earlier stages of the infectious fevers, as pneumonia and typhoid, or even in children when associated with mere gastro-intestinal disorder or dentition. But with the diagnosis made sure, as we believe, in the manner I have hinted at, quite a considerable number of cases of recovery can be found on record. For instance, Dr. Alfred E. Martin collected from the literature between 1894 and 1909—that is, over a period of 15 years—some 20 clear cases, and in addition to these were a still larger number of almost indubitable cases in which, however, those rigid conditions were not entirely satisfied.

In addition to these, were numerous cases in which remission of symptoms occurred for periods, in some instances, extending to months and even years; also there were cases, not by any means few in number, in which obsolescent tubercle was found *post mortem* in the meninges, in which the fatal event had resulted from some other disease or from a recrudescence, after a more or less lengthy interval, of the same disease. Moreover, beyond all this it does not seem unfair to argue, as I have already suggested, that

some of the recoveries from illnesses, having all the clinical character of tuberculous meningitis, but in which bacilli were either not found in the cerebro-spinal fluid or were not looked for, were really cases of tuberculous meningitis, the diagnosis having been wrongly discarded on the strength of the recovery alone.

As to treatment of cases of supposed or proved tuberculous meningitis, many remedies of the nature of medicine have in the practice of some physicians seemed to be of real efficacy in ameliorating the symptoms, and the same remedies in the hands of others have appeared to be absolutely without benefit, so that it would seem that no known medicinal remedy can confidently be looked to for material help.

It appears, however, to be established that, in some cases, lumbar puncture, frequently repeated or not, has been of value in this well-nigh hopeless disease, as in cases of meningitis due to other organisms, and that in other cases, even when a fatal result has eventually occurred, the course of the disease has been modified favourably. The method is, at any rate, without any considerable risk, and the disease is desperate, so that, in the hope in any individual case the infection may be neither virulent nor extensive, it would seem that it might well be adopted as a routine procedure. But in this recommendation, I would not myself include the method of combining the injection of tuberculin with lumbar puncture, for nothing can be more certain than the effect of tuberculin in inducing swelling in tuberculous tissues; and, as we have seen, some of the dire effects of the disease may fairly be ascribed to increased intracranial pressure, so that, speaking for myself, at any rate, on the score of risk, if on no other, I would have no part or lot in the exhibition of tuberculin in this disease. Putting the question of tuberculin aside, if, as Sir Thomas Barlow has said, there be in any individual case a wide-spread cerebritis and softening, with much hydrocephalus and plugging of vessels, the state of affairs is doubtless too formidable for surgery to remove, to which we may add in no mere faint-hearted spirit, "and perhaps just as well."



TUBERCULOSIS IN CHILDREN.

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THE history of tuberculosis in childhood presents one of the most remarkable records in the whole domain of medicine. As a disease it was scarcely recognized 100 years ago, when Laennec called attention to the similarity between scrofula and consumption. Then came Villemin's inoculation experiments in 1865, and the discovery of the tubercle bacillus by Koch in 1882. From this time forward, ideas began to widen with respect to the frequency of tuberculous lesions in childhood, but even at the end of the last century, but 12 years ago, the current belief was that in not more than about 20 per cent. of children dying from all causes were tuberculous foci to be discovered.

By the year 1905, our conceptions as to the prevalence of the disease had again greatly expanded, for Harbitz¹ had already published his pathological statistics for Christiania, which showed that 42 per cent. of all children who died had foci of tuberculosis; while Hamburger and Sluka's² figures for Vienna were 40 per cent.; and Comby's³ for Paris 38·5 per cent. Two years later (1907), Wolff-Eisner⁴ described a method of using the eye-reaction to tuberculin as a test for tuberculosis, and this test, modified by Calmette,⁵ and now generally known as the ophthalmo-tuberculin-reaction, or "Calmette's test," was up till quite recently largely used as a means of diagnosing tuberculosis in children. This test was rapidly followed by Von Pirquet's cutaneous test and Moro's inunction test, both of which were considered, as compared to Calmette's method, to have the advantage of greater safety.

The result of the application of these tests to large groups of children was to show, that a very much greater proportion is infected with tubercle than had hitherto been computed by post-mortem findings. This discrepancy, between the evidence

of the tuberculin test *intra vitam* and the evidence of the pathologist *post-mortem*, encouraged a more careful search by means of the microscope and guinea-pig inoculations, both for the bacillus itself and for its inflammatory products, with the result that the number of positive findings may almost be said to be proportionate to the care and patience exercised in the search.

Hamburger has found as high an incidence as 53 per cent. of tuberculosis in children between the ages of 11 and 14, who have died from all causes, and careful search for the bacillus *intra vitam*, in the sputum of infants at the Babies' Hospital in New York, has revealed its existence in a totally unsuspected number of cases (Holt).⁶ By means of the tuberculin test, Hamburger and Monti⁷ have claimed a tuberculosis incidence of 90 per cent. in the case of school children in Vienna 14 years of age, an incidence of 70 per cent. in children between the ages of 7 and 8, and an incidence of 20 per cent. during the third year. Astonishing though these figures are, they have been substantiated and confirmed for Paris by Mantoux,⁸ for Düsseldorf by Nothmann,⁹ and for Prague by Ganghopner.

Thus, the popular German saying, that "am Ende hat jeder Mensch ein Bischen tuberculose," in the light of modern knowledge might equally well read, "von Anfangen hat jeder Mensch ein Bischen tuberculose," for, within the short compass of 100 years, a disease almost unsuspected below the age of puberty has come to be regarded not only as the commonest of all diseases affecting childhood, but practically as a universal disease among the children of the proletariat classes.

Although it has definitely been established, from clinical observation and from experiments on animals, that a foetus can be born of a tuberculous mother with the disease in full efflorescence, such an event is so exceptional that for all practical purposes congenital tuberculosis may be excluded from the category of clinical probabilities. On the other hand, most authorities are agreed that there exists a distinct type of child, recognizable by physical and physiognomical characteristics, which lightly lends itself to the invasion of tubercle, and offers but feeble resistance to a fatal extension

of its activities. Such a type is known as the phthisical type, and the diathesis on which it depends as the "habitus phthisicus." This type, which is distinctly hereditary, and tends to appear and reappear in certain families, has probably little ætiological connection with those congenital conditions of malnutrition, which are recognized as being dependent on intra-uterine poisoning of the embryo or fœtus with the circulating toxins of a tuberculous mother, and which, according to certain observers (Nathan Larrier, Delamare, Sicard), sometimes assume the form of a definite infantilism.

In contra-distinction to the incidence rate of tuberculosis in childhood, which starts at zero and rapidly rises to 90 per cent. at the age of 14, the mortality rate among the new-born is enormously high, and rapidly sinks as the child reaches the third year of life; thence onwards up to the period of adolescence, it remains uniformly low.

According to Hamburger and Monti, the mortality rate among children infected during the first two months of life is 100 per cent., at the end of the first year, 50 per cent., at the end of the second year, 20 per cent., and from the fourth year onwards probably remains at so low a figure as 2 per cent. We arrive then at the following important conclusions:—

Tuberculosis is the commonest of all diseases to which childhood is liable. The congenital form of the disease is practically unknown, although the phthisical diathesis is strongly hereditary, and predisposes to the subsequent development of tuberculous processes.

The incidence rate rises from zero at birth to 90 per cent. at the age of 14. On the other hand, though tuberculosis is a terribly fatal disease during the first few months of life, the mortality rate among those affected rapidly falls to about 2 per cent. at the end of fourth year. Thus, as far as tuberculosis is concerned, children may be said to be highly susceptible, but, with the exception of the first two years of life, little liable to fatal results.

The vexed questions of the sources of infection and the channels of infection have so far received no final answer, although opinion is steadily veering round to the view that infection is usually from human, and only occasionally from bovine, sources. Gaffky's clinic has supplied some very

valuable contributions¹⁰ to the general literature, with respect to the origin of infection. In these investigations, covering in all some 400 cases, an attempt has been made to differentiate between the human and bovine type of infection in children, by inoculation and sub-inoculation of guinea-pigs and rabbits; and relying on the varying degrees of susceptibility of these animals, the investigators claim to be able to distinguish between the two types. On the result of the experiment, it is estimated that 98·68 per cent. of the cases investigated were of human and only 1·32 per cent. of bovine origin.

On the other hand, from the united findings of our own Royal Commission and that of an Imperial Enquiry in Germany—enquiries which cover some 133 cases of tuberculosis in children—it was estimated that 33 were of bovine and 100 of human origin. Clinical evidence strongly bears out the probable preponderance of the human type. Schlossmann¹¹ points out that, in almost every case of infection among young children, enquiry elicits not only a possible but a probable source of infection in the home itself. Moreover, approaching the question from the converse point of view, it will generally be found that in those cases in which the father or mother is suffering from active phthisis or from open tuberculosis of any kind, the children also are extremely liable to become tainted with some variety of the disease.

Human infection, as Schlossmann clearly indicates, can be brought about by direct contact, as in kissing, though, as a rule, it is probably air-born, and conveyed to the infected individual indirectly in the form of dust or spray (Flügge, Cornel.) With respect to the bovine type, it is impossible to escape from the conclusion that unboiled milk from a contaminated source is almost the sole source of infection (Nocard, Brouardel).

To trace the bacillus, whether air-borne, food-borne, or otherwise conveyed, from its point of entrance into the body to the seat of its deposition and proliferation in the tissues has exercised the brain of many an observer. For some reason or other, there is a disposition to believe that air-borne bacilli more usually penetrate the mucous membrane of the respiratory system, healthy or otherwise, and find lodgment in the bronchial glands, while food-borne bacilli pass down the

alimentary canal, penetrate the bowel wall, and come to rest in some abdominal lymph node. When we consider the extremely limited probability of air-borne bacilli escaping the moist mucous membrane of the nose, naso-pharynx, and mouth, and of passing with the air down the larynx, trachea, and bronchi, we cannot help doubting this ear-marking of air-borne bacilli for the so-called respiratory route. It seems reasonable to suppose that air-borne and food-borne bacilli incur practically the same liability of being swallowed.

Nearly all observers are now agreed that the bronchial and peritoneal glands are infected in about equal proportions, this could hardly be the case if most air-borne bacilli enter by way of the respiratory route. Since air-borne bacilli of human origin are acknowledged to be the common sources of infection, there should be a marked preponderance of infection of the bronchial glands, but this, as already stated, is not the case.

In considering the claims of the various hypotheses, it must be remembered that there are good grounds for believing that the tubercle bacillus is able to penetrate healthy mucous membrane without leaving any trace of its passage; that it can pass without let or hindrance along the lymphatic channel; and that it is not necessarily brought to rest in the substance of the first lymph node through which it passes. It is, therefore, well within the range of possibility that a bacillus, no matter what may be its source of origin or its mode of entrance to the body, can wander at large through the system until it is brought to a standstill at some conveniently situated resting place. The fact that tubercle bacilli have been found in the milk of tuberculous cows, quite apart from the disease of the udder, lends support to this hypothesis.

As a matter of fact, we know that lymphatic glands are the favourite seats of election, but we do not yet know why one gland is chosen and another left. There are, however, strong grounds for supposing that lymphatic glands in the drainage area of catarrhal or otherwise diseased organs constitute zones of special danger. May it not, therefore, be the case that tubercle bacilli, by whatever route entering the body, are not necessarily held up in locally situated glands, but that they may wander at large through the system and

are ultimately arrested in some partially occluded or inflammatory lymph gland, which presents a barrier of inferior permeability?

Without suggesting for one moment that the controversy has reached finality, I would summarize the more important aspects of the question by saying, that *tuberculous disease is generally of the human type and conveyed by direct contact or through the medium of the air; that the bacilli may enter the system by several routes; and that they are ultimately arrested in lymph nodes, the permeability of which to solid matter is impaired, or which otherwise offer a favourable nidus for growth.*

The clinical and pathological distinctions between tuberculosis as it affects the child, and tuberculosis as it affects the adult, become more and more striking as we descend the scale of life. In infancy itself, at any rate during the first six months of life, the course of a tuberculous infection is so utterly unlike the clinical picture we are accustomed to find in later life, that failure to diagnose the condition is quite excusable unless meningeal symptoms give the clue to the situation.

As already indicated, tuberculosis in childhood is essentially a disease of the lymphatic system; in young and previously uninfected subjects, the invasion can take place and inflammatory neoplasms result without the manifestation of any constitutional symptoms, there may be no rise of temperature no signs of a general poisoning of the system, nothing to attract attention. This is because in such subjects "sensitiveness" has not yet been acquired, in other words, the tissues have not yet learned how to destroy the invader by bacteriolytic processes with the production of those toxic substances which, though essential for immunity, give rise to the constitutional symptoms in sensitized subjects. Thus in the infant, and to a lesser extent in the young child, the tuberculosis process can extend rapidly with only such detrimental influence to the general health as is occasioned by the mechanical interference with the function of the organs implicated. In the diseased areas there is, as it were, a damming back of the lymph stream and an extension of the tuberculous process towards the organ which is drained by the lymphatic channels involved.

Thus, in the case of a primary affection of the bronchial glands, the inflammatory process may extend along the lymphatic vessels at the base of the lung, involve the adjacent pulmonary substance, and give rise to that massive consolidation which is now generally known as Hilus disease. In children, this marked tendency to rapid growth and subsequent caseation is most characteristic. Reparative processes are conspicuous by their absence, and those changes which take place are destructive rather than protective, in that there is no shutting off of dangerous foci by fibrosis and calcification. The disease tends to spread along the lines of least resistance, and generalization takes place so rapidly that meningitis is extremely common; generally speaking, the younger the child the more rapidly does this result ensue.

The absence of constitutional and focalizing symptoms makes the diagnosis of tuberculosis in young children extremely difficult. Thus, infants may literally be riddled with tubercles, and older children may have extreme involvement of the mediastinal or peritoneal glands, without the exhibition of any serious impairment of health or constitutional symptoms. Wasting is by no means an essential feature until the disease is very far advanced, although infants, as a rule, come to a standstill and fail to put on weight, no matter how carefully their dietary is arranged. The temperature chart shows irregularities, but seldom those great fluctuations characteristic of the tuberculous process in adults. In all suspected cases, the temperature should be recorded for as long a period as possible, and at varying times of the day. Sweating is a common symptom, but so it is of many other childish complaints, therefore little reliance can be imposed on such evidence. Speaking generally, the older the child the greater is the significance of sweating, as a diagnostic point in favour of tuberculosis. A child, 12 years of age, who regularly suffers from profuse perspiration at night, with beads of cold sweat showing on the face and forehead, is probably actually tuberculous or at least a candidate for tuberculosis. General lassitude, a poor appetite in the morning, and buoyancy of spirits alternating with periods of depression, are all in favour of tuberculosis.

The one infallible proof of tuberculosis is the discovery of

the bacillus in the sputum, in the emunctories, in the discharge from wounds, or in the cerebro-spinal fluid. The painstaking search for this incontrovertible evidence of the disease is now, owing to improved methods of clinical research, more often rewarded with positive findings than was formerly the case.

The tuberculin tests—Calmette's conjunctival test, Von Pirquet's puncture test, and Moro's inunction test—depend for their success on a local reaction at the seat of inoculation. This reaction is due to the generation of specific antibodies, which break down the tuberculin molecule and produce toxins. These toxins irritate the tissues locally, and give rise to the inflammatory blush by which the reaction is recognized (Wolff-Eisner). The capacity to elaborate these antibodies is known as sensitiveness; it is a capacity which has to be learnt by the young and inexperienced organism, in the same way that it has to learn to digest foreign proteids and carbohydrates in the alimentary tract. Hence, there can be no reaction to tuberculin, except in the previously infected.

Inasmuch as the majority of children over 5 years of age have already been infected, and inasmuch as 90 per cent. of children over 14 years of age have had experience of a tuberculous invasion, it follows that this test is more valuable, when negative, as a means of excluding tuberculosis, than when positive, as evidence that any group of symptoms are actually due to tuberculous disease.

During the first two years of life, when tuberculosis is rare, and its consequences more serious, the tuberculin test—Von Pirquet's for preference—is most useful. The subcutaneous injection of Koch's old tuberculin can be employed as a means of focalizing latent tuberculous disease in children. For, in addition to the constitutional symptoms, fever, malaise, etc., which such inoculation causes in infected subjects, there is a local reaction at the hidden seat of the mischief, which may be demonstrable by the ordinary means of physical examination. On the principle that "it is better to let sleeping dogs lie," this method of diagnosis is not to be recommended for use by the inexperienced.

Inasmuch as the constitutional symptoms of tuberculosis in children are by no means pathognomonic, and inasmuch as the specific tests are not always available, it is to the

lymphatic system that we must appeal for the clinical data on which to base a reliable diagnosis, for, as has already been pointed out, it is the lymphatic system which first bears the brunt of the attack, and it is while confined to the lymphatic system that the disease offers the best opportunities of cure.

For evidence of enlarged glands, we must search all areas accessible to palpation, and in this connection I would lay considerable stress on the diagnostic significance of swollen glands in the axilla the tumefaction of which cannot be explained on other grounds. Enlarged glands in the neck are so often due to eczema of the scalp, pediculi, and the troubles of dentition, that early enlargement should be regarded rather as a predisposing cause of tuberculosis than evidence of its actual presence.

The pelvis and lower part of the abdomen is, in infants, peculiarly accessible to palpation through the rectum, and, even in older children, it is astonishing how far the exploring finger can reach.

Whether discovered "*intra vitam*" or not, enlargement of the mediastinal glands exists to the extent of some 80 per cent. in all tuberculous cases which come to autopsy, and therefore in any given case of tuberculosis in children the mediastinum is the one situation that should thoroughly be investigated by every available means. The following are the more common signs and symptoms of tuberculous adenitis in this situation :—

- (1) A hollow spasmodic cough without expectoration or obvious cause, such as tonsillitis, naso-pharyngitis, ear trouble, or bronchitis.
- (2) Impairment of resonance, especially to the right of the sternum at the level of the second intercostal space in front, and in the interscapular region behind.
- (3) Enlargement of the superficial veins in the upper third of the chest, especially when unilateral, on the right, and radiating from the coracoid process to the sternal end of the second intercostal space.
- (4) Inspiratory stridor heard universally over both lungs, due to pressure on the trachea (Still.)

- (5) A defective entry of air into one lobe, due to pressure on bronchus.
- (6) The development of a bruit at the inner end of the clavicle on forcible extension of the head (Eustace Smith).
- (7) Pleuro-pericardial friction rub (rare).
- (8) Tracheal character of voice heard on auscultation below the usual level of seventh cervical spine behind (d'Espine).
- (9) Evidence of skiagram, distinct in advanced cases, unreliable in recent cases.

Tuberculous glands in the abdomen, though discoverable post-mortem in about 88 per cent. of children dying from tuberculous diseases of all kinds, are seldom detected *intra vitam* unless the disease is far advanced. The most likely position in which to find these glands during life is in the right iliac fossa or to the left of the vertebral column at the level of the umbilicus. Ulceration of the bowel, again a somewhat late complication, may be suspected when there is blood in the motions, and confirmed by the discovery of the bacillus. Irregularity of the bowels and intermittent colicky pains, though also symptomatic of simple colic or enteritis, are confirmatory tests of some value.

When there is extension of the inflammatory process with matting of the intestines and their mesenteric attachments, there is often a somewhat characteristic appearance of the abdominal wall. The skin is dry, loose, and wrinkled, with a curious inelastic feel on palpation, which offers little resistance to the hand and allows of easy movement of the intestines beneath, which generally give the impression of moving *en masse*. With ascites, the abdomen is distended, tympanitic in front, and dull in the flanks. With extensive involvement of the omentum by the inflammatory process, a distinct tumour can be felt, stretching across the abdomen in an upward direction from right to left, just above the level of the umbilicus.

As already stated, the constitutional symptoms of an early tuberculosis in childhood are neither pathognomonic nor severe, and from what has already been said with respect to the signs and symptoms of involvement of the lymphatic

system, it will readily be understood that the diagnosis is extremely difficult in the majority of early cases. There is, however, a further complication in the diagnosis, which is very closely concerned with the subsequent steps which are suggested by way of treatment, and this complication is, that since practically all children are "ein Bischen tuberculose," it is more important to be able to prognosticate the probable course of events than merely to make the diagnosis of the presence of tubercle. A reliable prognostication of this kind cannot be made in the stress of out-patient practice, nor by a single examination in the consulting room. Many factors must be taken into consideration—the family history, the nature of the exposure to infection, the evidence of the temperature and weight charts, the response to treatment, and the many other imponderabilia of prognosis which take time and trouble to ascertain.

With respect, then, to the diagnosis of tuberculous disease in children it may be stated generally that it must depend on a full consideration of the constitutional symptoms, of the evidence afforded by the specific tests, and of the results of a careful examination of the lymphatic system. Although in early infancy, the gross diagnosis of a tuberculous affection is all important, in later childhood the mere diagnosis of the presence of tubercle is less important than a reliable estimation of the extent to which the tuberculous process is under the control of the natural resources for defence, and the extent to which it is likely to gain a hold on the subject.

The treatment of tuberculous conditions in childhood must be considered both from the prophylactic and the therapeutic point of view. During the first two years of life, preventive measures are far more important than lines of treatment designed to mitigate or cure the established disease, for, as we now know, infection during this period is almost tantamount to a sentence of death. On the other hand, in later childhood, there is not wanting evidence to show that mild infections are necessary steps towards immunization.

Childhood is a period of life in which the organism learns to protect itself from the many dangers which assail it in the environment, and the really useful citizen is he who has been put to the proof of successive infections of different

kinds, and has emerged successful and immune. The child, who, at adequately extended intervals, has successively and safely survived tuberculosis, measles, whooping-cough, and scarlet fever, is, from an economic point of view, of more value than one who has been sheltered and protected from all possible sources of infection, and whose troubles are still to come.

The two outstanding factors in successful prophylaxis, as far as tuberculosis is concerned are :—

- (1) Protection from sources of infection during the first two years of life, when the disease is so intensely fatal, and
- (2) The maintenance of strength, during later years of childhood, at those special times when the organism is least prepared to protect itself against serious extensions of the tuberculous process.

With respect to the first of these two important desiderata, it may be stated that the most essential step is to remove young infants from an environment of open infection. When the mother is the subject of declared phthisis and has tubercle bacilli in her sputum, it is almost inevitable that the child will become infected. And, within limits, the same is true when the nurse, the father, brothers, or sisters are in a similarly dangerous condition. As Bierner has aphoristically stated it, "tuberculosis is a bedroom disease." Although no prophylactic measure can compare in importance with the removal from sources of open infection, there are other preventive expedients useful in all cases, but particularly to be studied in those cases which, without being exposed to known sources of open infection, are specially liable to accidental contamination.

Damage of any kind to the lymphatic system, as affording seats of lessened resistance, enhances the chance of a serious tuberculous invasion. Thus, all factors which predispose to catarrhs predispose also to tuberculosis. Such conditions are, confinement indoors, ill-ventilated rooms, dust, excessive clothing, and too much warmth. I believe that there are few prophylactic measures against the colds and chills, to which infants are subject, to be compared to the regular

employment of the graduated cold bath, and by this I mean a bath the temperature of which is gradually reduced from 100° F. by, say, one degree daily, until it is given almost cold. I employ this method with uniformly good results, in the case of most of the infants of tuberculous parentage who are brought to my Infant Consultations in Marylebone.

Then, again, purely as a prophylactic measure, I believe there is a great deal to be said in favour of a varied and liberal proteid diet, whether the infant is breast-fed or bottle-fed. In addition to the ordinary milk diet, small supplementary feedings of raw meat juice, yolk of egg, plasmon, and other easily digested forms of albuminous food can in either case be given with advantage, even in the case of quite young infants. Apart from my own practical experience of the advantages of thus amplifying the infant's protein diet, I think there is a rational explanation of its benefits, in the view that immunity to all forms of infective disease must be a function of proteid metabolism. On this assumption, within limits, the more proteid metabolism is encouraged by liberal and varied experiences, the more likely is the organism to learn how to deal with such foreign bodies as bacterial toxins, which are themselves nitrogenous. The fact, that carnivorous animals are less liable than herbivorous animals to many forms of infection, is in support of this view, so also is the well-known fact that sugar-fed infants, and indeed sugar-fed animals, are extremely liable to infectious diseases of all sorts, and especially to tubercle.

After the second year of life, when protection from infection ceases to be so urgent a necessity, our energies should be directed towards supporting the strength during those special periods when tuberculous disease is known to run a serious course. Such times are, of course, during the convalescent stages of measles, whooping-cough, chicken-pox, and, to some extent, of scarlet fever. At such times removal to the sea or to bracing country air is one of the most satisfactory and indeed one of the most economical measures that can be employed in prophylaxis. When the above mentioned infective disorders attack children in rapid succession, leaving no time for complete convalescence before the advent of the next, I think that every effort should be made to remove

the patients to the seaside or to the country, for not only are such children practically certain to be already tuberculous, but it is also equally certain that during this period of debility the tuberculous process will make considerable headway.

Let me then sum up what I consider to be the most important essentials in the prophylactic treatment of tuberculosis in children.

As far as infancy is concerned, the only satisfactory measure when the environment is known to be one of open infection is to remove the infant from the source of danger. As supplementary prophylactic measures, fresh air, the graduated cold bath, and an ample and varied proteid diet are useful. For older children, the one important measure, apart from the above, is to maintain their strength during the period of debility following measles, whooping-cough, and chicken-pox, and to remove them to convalescent homes in the country.

The treatment of established cases of tuberculosis in children may, for convenience' sake, be discussed from two points of view: firstly, from that of specific inoculation, and secondly, from that of medicinal and hygienic therapeutics.

With respect to the tuberculin treatment, which has now become almost a special branch of medicine in itself, I would refer the reader to Rivière and Morland's excellent little work, entitled *Tuberculin Treatment*.¹² In view of Nature's beneficent methods of natural immunization during the period of childhood, and the highly satisfactory results which reward obedience to the general principles of hygiene, the specific lines of treatment appear to me to be uncalled for in the great majority of cases, although no doubt they have their value in cases of surface tuberculosis, which can be watched, and in surgical cases which are amenable to operative treatment.

In the fatal period of infancy, after the tuberculous process has gained a footing in the system, the tuberculin treatment has an extremely limited range of utility; and further, it cannot be applied as a prophylactic measure before infection with the bacillus, however desirable such a line of treatment might appear on theoretical grounds. As far as infants are concerned, the most useful application of the method

is probably in those cases in which the exact moment of infection has been determined by the periodic and regular application of Von Pirquet's test. The small dose method then holds out some prospect of affording artificial aid to the natural process.

The hygienic and medicinal treatment of established cases of tuberculosis does not differ materially from that of cases among older individuals, and much that has been mentioned above with regard to prophylaxis also applies to the cure. Climatic treatment, open-air treatment, open-air schools, the graduated cold bath, careful dieting, and a varied and liberal supply of nitrogenous food are all in their way necessary and desirable elements in the treatment.

Mr. Arbuthnot Lane has recently drawn attention to the association between intestinal stasis and the tuberculous process in children. Intestinal stasis, or any other condition that tends to intestinal toxæmia, is, in my experience, quite one of the most unfavourable elements in tuberculous disease. Tubercle, in whatever form existent, seems to me always to run an unfavourable course when it co-exists with intestinal intoxication, and for this reason attention to the bowel condition should always be one of our first considerations. I have long pointed out that, in all cases of intestinal intoxication in children, there is nothing which promotes the healthy function of the bowel so well as petroleum, given in the form of an emulsion and at comparatively short intervals. I give it, as a rule, in combination with liquor pancreatis as a digestive, and calcium hypophosphite as a tonic, and order it to be taken after each meal. For a child of five years of age, the prescription runs as follows:—

R	Liquoris Pancreatis	-	-	-	℥x.
	Calcii Hypophosphitis	-	-	-	gr. i.
	Emulsionis Petrolei	-	-	ad	ʒi—ʒii.

After each meal.

Of drugs which have, or are reputed to have, a specific controlling action on the tuberculous process, my main faith is centred in three, *i.e.*, calx sulphurata, for glands in the neck, especially when there is a mixed infection; iodides (syrupus ferri iodidi), in cases of plastic infiltration and general

debility ; and creasote, for all pulmonary or far advanced cases in which the digestive processes are not already disturbed. The really beneficial results of this drug, in my opinion, do not become apparent until the dosage usually prescribed is widely overstepped. With a child five years of age, I begin with one minim doses three times a day ; and gradually increase the dose to 20 drops or even more, but it is not till the patient is practically saturated with the drug that the specific action, if such it can be called, becomes really apparent. It is best given in an emulsion of cod-liver oil.

In conclusion, then, it may be said that the *tuberculin treatment* has a definite though limited place in the curative treatment of tuberculosis in children, the most valuable expedients, however, are climatic, dietetic, and general hygienic treatment. The prevention of intestinal intoxication is a factor of great importance, while of drugs, calx. sulphurata, iodide of iron, and creasote are the most valuable.

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THE TREATMENT OF LOCALIZED TUBERCULOUS INFECTIONS.

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LOCALIZED deposits of tubercle in the human body do not possess the terrors to the physician and surgeon, which they undoubtedly did a generation ago. A more complete knowledge of the origin and pathology of such localizations, together with improved methods of treatment, have led us to approach them with more confidence, and, in the great majority of cases, with the hope of complete and permanent success.

At the International Congress on Tuberculosis held in London in 1901, the late Professor Robert Koch made the following declaration:—"That (1) tuberculosis of man and the cow were different, and that tuberculosis of the cow could not be conveyed to man; (2) that the regulations concerning milk, butter, and meat made against tuberculosis of animals and its transmission to mankind were not necessary."

The position of this interesting scientific problem at the present time is briefly as follows:—Koch held that human and bovine tuberculosis are separate and distinct diseases, and that bovine tuberculosis, if conveyed to man, cannot set up human tuberculosis. Koch, in addition, believed that phthisis is conveyed from one person to another by direct infection, especially from contact with an advanced case of the disease, and that this is by far the commonest cause of the spread of phthisis pulmonalis. Von Behring, on the other hand, holds diametrically opposite views. He says that human and bovine tuberculosis are the same disease, and that nearly all tuberculosis is the result of infection during infancy by means of infected milk, and that direct infection from person to person is not proved.

During the last 15 years I have had under observation over 6,000 cases of phthisis pulmonalis, and over 1,500 cases of what is called surgical tuberculosis. In addition to having had the opportunity of observing this large number of cases in the wards of a hospital, I have made over 1,200 post-mortem examinations on tuberculous cases, the great majority

of which were very carefully and minutely examined. In addition to this hospital work, for the last eight years I have been conducting a special research into the distribution of tuberculosis in Liverpool, and have made a large number of experimental and other observations in the Pathological Department of the University of Liverpool.

The general results and impressions of that work are given in this paper, but, in the short space at my disposal, it is impossible to do more than touch generally on a few of the more important problems opened up by this research. I would like to follow up the lines of my original paper of 1903—since I have no reason to modify the view then set forth—namely, that human and bovine bacilli are divisible into two distinct types of a common species:—

1. *Typhus humanus*.
2. *Typhus bovinus*.

During the last eight years I have made a very large number of pure cultures of tubercle bacilli from various sources—human, bovine, and avian—and after growing a very large number, one is bound to admit the distinctive cultural differences on the same medium between human and bovine bacilli. All are agreed on the distinctive characteristics of avian bacilli.

Long-continued residence in a particular host has resulted in the bacillus assuming characteristics which serve to distinguish it from others, and the fact that tubercle bacilli have lived for thousands of years in human lungs would be ample evidence for assuming a difference between bacilli which had lived for centuries in cattle.

Another fact of the most profound importance in studying this problem is that for centuries man has been accustomed to feed upon cattle and their products—milk, butter, cheese, etc., and in this way the human body has become tolerant to bovine bacilli. Whilst I firmly believe that human and bovine bacilli are different types of parasites, yet I am convinced that bovine bacilli are freely communicable to humans, and are the cause of a large amount of tuberculosis in children. I believe that man is attacked by two distinct varieties of tubercle: one conveyed by infection from person to person, the other by receiving into the body bovine bacilli from infected food. In other words, the human body is susceptible

to both forms of tubercle. The difficult problem to determine is, what particular lesions in the human body it is each variety of tubercle produces.

LYMPHADENITIS TUBERCULOSA.

This is a very frequent infection in children, and is, in my opinion, almost always the result of drinking milk containing tubercle bacilli. The bacilli are arrested by the tonsils or in the cavities of carious teeth, and thence conveyed direct to the neighbouring lymph glands. There can be no doubt that children vary enormously in their susceptibility to glandular infection. Many of them drink milk, containing virulent bacilli, for long periods and escape infection, whilst others have only a small quantity of such milk and are immediately attacked. Whether this variation is due to an increased resistance to bacillary infection, or to a special predisposition to attack by the tubercle bacillus, is not yet determined, but my experience is in favour of the former.

The infection may be exhausted in the glands, which then subside (*restitutio ad integrum*), or persistent induration may follow, or some pyogenic infection may be superimposed, resulting in suppuration and unsightly scars. If the glandular infection is neglected, it may extend down to the clavicle and directly infect the glands of the anterior mediastinum, resulting in pulmonary tuberculosis. I have observed 38 such cases during the last 15 years, and post-mortem examination has confirmed the diagnosis of direct infection of the lungs from the neck glands.

TREATMENT.

In no department of our profession has a greater change taken place than in the treatment of localized tuberculosis. Whatever line of treatment is adopted, it is of prime importance to commence it as early as possible.

With regard to surgical interference, I have come to the conclusion that as little as possible should be done with the knife. When one large gland is involved and there is evidence of caseation, it should be punctured and the contents evacuated; in the case of general suppuration with extensive periadenitis, free incisions to liberate pus should be made. In all other cases, conservative measures should be adopted, and special attention should be directed towards improvino

the general nutrition by residence at the seaside, plenty of nourishing food, and, above all, a good supply of cod-liver-oil.

It must be remembered that a neglected tuberculous gland is a potential danger. At any time the bacilli may be liberated into the blood stream, resulting in a generalized tuberculosis; hence the urgent necessity for every tuberculous focus to receive adequate and immediate treatment.

TUBERCULIN.

This valuable and powerful remedy gives us the best results in the treatment of tuberculous glands. The infection, being of bovine origin, requires for its treatment a tuberculin prepared from human bacilli, as more complete immunity seems to be produced in the human body by using opposite tuberculins.

The dosage of Koch's new tuberculin (T.R.), human, is as follows:—

*0001 mg.	*001 mg.
*0002 „	*004 „
*0004 „	*006 „
*0005 „	*0075 „
*0006 „	*008 „
*0008 „	*01 „

The injections are given weekly, special watch being kept on the temperature and pulse. It is rare to observe either a local or general reaction if the above dosage is carefully followed.

A point of great importance in the administration of tuberculin is, that we must be satisfied that there is no suppuration pent up in the body; otherwise, the injection of tuberculin, by setting up a local activity in or near a tuberculous focus, may inadvertently liberate the bacilli, and cause general infection. All pus should, therefore, be liberated before any tuberculin is administered. My results of treatment in over 200 cases of glandular tuberculosis are most encouraging, and I now use tuberculin as a routine practice, in combination with general constitutional remedies, as, in addition to reducing the glands, tuberculin seems to have the effect of preventing a further infection in the body. Many cases are of long duration, and require a great deal of patient treatment, but in the end they tend to heal, and, as a general rule, the cure is complete.

RAIN-BEARING WINDS AND THE PREVALENCE
OF TUBERCULOSIS.

By WILLIAM GORDON, M.A., M.D., F.R.C.P.

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THE relation of rain-bearing winds to the prevalence of tuberculosis is a problem of far-reaching importance, and the more it is studied the further does its importance appear to extend. If we admit, as we must, that *populations exposed to strong, prevalent, rain-bearing winds tend to suffer appreciably more from pulmonary tuberculosis than populations sheltered from them*, it becomes imperative to consider the wind-exposures of the districts to which we propose to send either arrested cases of phthisis, or persons with pronounced hereditary proneness to the disease. That alone is far-reaching. Yet the consequences of this study do not seem to rest there; and it will be observed, as I review the considerable mass of evidence which has now been accumulated, that these consequences reach out in several directions in a very remarkable manner.

Thus, at the present time, when it is probable that many tuberculosis sanatoria will shortly be erected in various parts of this country, it has become questionable how far it will be wise to expend large sums of money in conscious negligence of an influence, which may conceivably interfere with expected success; and similarly questionable, in future enquiries into the laws governing the spread of tuberculosis by milk, how far it will be prudent to ignore intentionally a factor which may take its revenge by rendering the investigation abortive.

In the space at my disposal, it will be understood that it is only possible to offer the barest outline of more than twelve years' work; references, however, will be given for any who may desire to form their opinions from the original publications.

THE EVIDENCE.

In order to emphasize its remarkably cumulative and corroborative character, I have arranged the evidence under

twelve headings.

1.—PULMONARY TUBERCULOSIS; THE TEST OF FOUR RURAL SANITARY DISTRICTS OF DEVONSHIRE, SEPARATELY EXAMINED IN THEIR PARISHES.¹

A survey of the distribution of phthisis in the sixteen rural sanitary districts of Devon, thus avoiding the large towns and, especially, the health resorts, having strongly suggested that exposure to west and south-west winds tended to increase the mortality from the disease, a searching test was adopted to ascertain whether this were so or not. Four separate rural sanitary districts in different parts of the county, with an aggregate population of 85,209 persons, were examined in respect of the phthisis death-rate in their parishes (the small areas of parishes permitting surer comparisons of shelter and exposure), and, in every district, the correspondence between relative exposure to west and south-west winds and relatively great phthisis death-rate was found to be strikingly apparent—the actual ratios of the death-rates in the exposed parishes to those in the sheltered, being 5·5 to 1, 3 to 1, 3 to 1, and 3 to 2.

2.—PULMONARY TUBERCULOSIS; THE TEST OF OKEHAMPTON RURAL DISTRICT, COMPARING THE INFLUENCE OF WINDS FROM DIFFERENT QUARTERS AND USING ONLY FEMALE DEATH-RATES, 1890-1899.²

After it had been urged, (*a*) (rightly) that female death rates would furnish a safer basis of enquiry than mixed death-rates, and (*b*) (wrongly) that exposure to wind from any quarter might be equally hurtful, Okehampton Rural District, with a female population of 7,273 (1891), in the centre of Devon, presenting specially marked contrasts of exposure and shelter in respect of different winds (the south alone practically not reaching it) was selected for investigation, and from it were constructed, not merely tables, but, to make the test severer, maps, of the parish phthisis distribution and of the parish exposures and shelters to S.W., W., N.W., N., N.E., E., and S.E. winds. In this undertaking, I had the great help of my friend, Dr. E. H. Young, the Medical Officer of Health. The death-rates in the parishes fully exposed to both west and south-west winds were found to be relatively high—usually very high—whilst those in the parishes fully sheltered from both winds were relatively low—usually very

low; the average death-rate in these exposed parishes was nearly five times as great as that in the sheltered parishes; and amongst them there were no exceptions. The correspondence in the maps relating to this comparison was, if possible, even more remarkable.³ On the other hand, neither tables nor maps indicated any correspondence between exposure to other winds and phthisis mortality, except in the case of the north-west wind, which seemed to be injurious, though to a less degree.

Yet during 1890-1899, the north-west wind had been unusually infrequent; clearly therefore this wind, the third chief rain-bearing wind of Devonshire, had in future also to be taken into account.

3. PULMONARY TUBERCULOSIS; THE TEST OF 23 PARISHES OF
BARNSTAPLE RURAL DISTRICT, EXAMINED DURING THE 45 YEARS (1860-1904)
IN SUCCESSIVE LUSTRA AND OTHERWISE, USING FEMALE DEATHS ONLY.¹

It had been objected (unreasonably) that ten years was too short a period on which to found any definite conclusion. So another specially suitable area, as regards contrasts of exposure and shelter, consisting of 23 parishes of the Exmoor part of Barnstaple Rural District, was examined over a period of 45 years. In this work, I had the great help of the Medical Officer of Health, my friend, Dr. J. S. Harper; and special pains were taken to make the most of the valuable meteorological and geological information which were placed at our disposal. Here once more the same law came plainly into view. Not only was the effect of exposure to north-west, west, and south-west winds upon phthisis mortality evident for the whole 45 years, but it was evident for every one of the nine successive five-yearly periods except the first. Further, during the 20 years 1885 to 1904, in which Koch's discovery of the tubercle bacillus might be supposed to have made the diagnosis of phthisis more certain than formerly, the contrast in death-rates between exposure and shelter became more marked—2·29 per cent. as against ·97 per cent. Finally, in the decade 1890 to 1899, during which, as rainfall was notably lower, and the frequency of the north-west wind less, interference with the result by dampness of soil or the influence of that wind might be regarded as reduced, the death-

rates presented this striking contrast.

Exposure or Shelter.	No. of Parishes.	Female Popula- tion.	Female Phthisis Death Rate per 1,000 per Annum.
Exposed to W. and S.W. Some also to N.W.	11	3,088	1.00
Exposed to N.W. only - - -	4	1,113	1.1
Sheltered from S.W., W. and N.W.	8	1,022	0

4.—PULMONARY TUBERCULOSIS; THE TEST OF EXETER STREETS,
EXAMINED IN GROUPS OF SOILS, OF HOUSE-VALUES AND OTHERWISE.
USING FEMALE DEATHS ONLY. 1892-1901 ^a _b.

A report, issued by the Sanitary Authority of Exeter, dealing with the distribution of phthisis-mortality in those streets of the city in which deaths from the disease had occurred during the ten years 1892 to 1901, afforded an opportunity of applying another stringent test. For, not only could all the streets, whose roadways were exposed to S.W., W. and N.W. winds, be compared generally with all those whose roadways were sheltered from these winds, but the streets could be divided into groups according (*a*) to the soils on which they stood and (*b*) to the average rateable value of their houses, and a similar comparison could be carried out in every group. The total mixed population of the streets considered was 32,207. Only female deaths were used. "Made soil," whose inconstant and uncertain composition rendered it undesirable to include, was omitted from consideration. And once more the result was decisive.

Not only had the streets, whose roadways were exposed, about twice the death-rate of those whose roadways were sheltered; but, when the streets on different soils were compared as regarded exposure and shelter, the contrast persisted, the ratio becoming rather less than 2 to 1 on clay, rather more than 2 to 1 on sandstone, and more than 3 to 1 on gravel; and when streets of different rateable house values were compared, and arranged in 4 groups in a similar fashion, in every group the ratio of about 2 to 1 was maintained. Lastly, when specially exposed streets were compared with

specially sheltered streets, differences of soil being avoided by only considering streets on clay (these being the most populous), the mortality in the exposed streets was found to be almost four times as great as that in the sheltered, or, if due allowance were made for the effect of differences in the rateable values, more than four times as great.

5.—PULMONARY TUBERCULOSIS; THE TEST OF THE APPLICATION OF A
NEGLECTED PRINCIPLE OF CLIMATOLOGY ⁶.

There is a principle in climatology which has been neglected singularly, if, indeed, it has ever been recognized quite definitely, yet the importance of which, once indicated, is surely obvious. I have called it the *principle of approximate isolation of influences*. By such "approximate isolation" I mean, not merely the happy-go-lucky elimination of this or the other influence in the investigation of a third; but the systematic enumeration of all the known influences which may affect the field of enquiry, besides the influence in question, and their successive elimination from the problem, in one way or another, so far as that is possible. The process, naturally, is neither easy nor short. But to the neglect of the principle may confidently be ascribed much of the lamentable confusion which pervades climatology. Obviously, evidence, which survives so severe a test, should be strengthened considerably; and the evidence of the influence of strong, prevalent, rain-bearing winds on phthisis-prevalence having thus been tested,³ has emerged apparently as one of the most powerful influences known to affect the death-rate from the disease.

6.—PULMONARY TUBERCULOSIS; THE TEST OF A WORLD-WIDE ENQUIRY ^{3 7}.

Perhaps no section of the work has been understood so little as this essential test, nor any whose value has been recognized so imperfectly. Yet those who are conversant with the climatology of phthisis, must know that it was just the attempt to apply the "high altitude theory" world-widely that led to its breakdown. It should be evident to them that, if there is a fallacy in the conclusions so far reached, the most likely way to demonstrate it is by trying to apply it world-widely; yet, so far from breaking down, the previously drawn conclusions have been strengthened substantially.

Although the directly confirmatory evidence obtained in the process is by no means to be despised—much of it is, in fact, extremely valuable—it is on the *extraordinary absence of contradiction* that particular stress should be laid.

In merely fragmentary outline the course pursued was as follows :—The world was mapped out into regions, according to the arrangement of its rain-bearing winds, and each region was separately considered. Where works of reference failed, much valuable information was obtained by correspondence. The enquiry embraced England (considered in counties), Wales (in registration districts), Scotland (in counties), Ireland (in large towns), Norway (in counties), Sweden (in towns), Denmark (in towns), Prussia (in provinces), Switzerland (in townships of the Grisons), France (in towns in departments), Spain (in coast provinces), Italy (in provinces), Japan (in counties), United States (in “regions”), and a large number of other areas.

It is impossible, in a few words, to deal satisfactorily with the considerable mass of material which this research accumulated; therefore, for particulars, I must refer my readers to the original paper¹, or to my book.³ But one or two details of exceptional interest may, perhaps, advantageously be alluded to in passing. Three insular areas were supposed to constitute objections to an influence of rain-bearing winds, viz., Iceland, the Faroes and the Falklands; these were shown to have been studied imperfectly, and the objections based on them to be untenable. For, phthisis in the Faroes was found to have been under-estimated greatly; the rainfall in the Falklands and the more populous part of Iceland is very moderate (18 and 20 inches); in Iceland, the wind is mainly from the east, whilst most of the inhabitants live comparatively sheltered on the west; and the wind, in the Falklands, blows almost constantly from the west, and the people have placed their dwellings for the most part in shelter, and on the east. Two insular confirmatory examples may also be thought worth mentioning. From the map of the phthisis mortalities in the counties of Japan, it was found possible to deduce correctly the direction of the chief rain-bearing wind before discovering from a text-book what it is actually known to be. From the Sandwich Islands, which are referred to by Hann²

as affording "the finest example of the contrast" between a wet and windy side and a dry and wind-sheltered, Dr. Grace wrote to me that "the fact that the windward side is the bad side of the islands" (for phthisis) "is well recognized here."

PULMONARY TUBERCULOSIS; THE POSSIBILITY OF EXPLAINING AWAY EXISTING DIFFICULTIES IN THE CLIMATOLOGY OF PHTHISIS, IF THE INFLUENCE OF RAIN-BEARING WINDS IS RECOGNIZED.

Sir George Buchanan, in his second report⁹ on the relations of soil and phthisis (1867) wrote thus:—"In this year's inquiry, and in last year's also, single apparent exceptions to the general law have been detected. They are probably not altogether errors of fact or observation, but are indications of *some other law in the background that we are not yet able to announce.*" [The italics here and those just below are mine]. His exceptions can be accounted for reasonably enough, if the influence of rain-bearing winds is admitted.

Again Davidson, in his *Geographical Pathology*¹⁰ (1892) states that "it thus appears that no complete explanation can be given of the geographical distribution of phthisis in England. We have here to recognize the existence of a zone similar to that which is observed in the Rhine Provinces of Germany, and at certain altitudes in Switzerland, in which phthisis, *for reasons not yet understood*, attains a high degree of prevalence." The influence of these winds will reasonably account for all these facts.

8. PULMONARY TUBERCULOSIS; THE IMPOSSIBILITY OF SATISFACTORILY INVESTIGATING OTHER FACTORS IN PHTHISIS-CLIMATOLOGY, WHILST RAIN-BEARING WINDS ARE OVERLOOKED.

The influence of *soil* on phthisis prevalence is so much less potent than that of rain-bearing winds, that it obviously cannot properly be studied without taking the latter fully into account. But even such powerful influences as *occupation* and *density of population* need reconsideration. For the evil eminence of the tin-miner¹¹ may not be entirely occupational; he lives for the most part in a district swept by strong rainy winds. Also the midland coal-miner, who suffers less from phthisis than coal-miners in other parts of England, may not owe his good fortune altogether to the conditions of his

work, but partly also to the slighter exposure of his district to strong rain-bearing winds. Again as regards density of population, it has been shown in West Prussia and North America that in rainy wind-swept regions, the self-protection of a town from wind may more than compensate for its comparative crowding.³ It seems unnecessary further to multiply examples.

9. —PULMONARY TUBERCULOSIS; THE RELATION OF STRONG PREVALENT
RAIN-BEARING WINDS TO THE COURSE OF THE DISEASE.^{12 11}

It has lately been suggested that conclusions, regarding the influence of these winds on the prevalence of phthisis, would be strengthened by a demonstration that they also influence its course; and there is something to be said for this suggestion. Several lines of inquiry suggest themselves, which may be followed in order to ascertain whether these winds do exert an influence on the course of phthisis or not. We may, (1) make continuous clinical observations on phthisis cases in some single locality under varying conditions of wind and rain; (2) clinically observe and compare the effects on a series of phthisis patients of residence in sheltered and exposed situations; (3) compare the collective results obtained by similar methods at differently located sanatoria—some in shelter, some exposed; or (4), lastly, we may compare the average durations of fatal cases, whose course has been run in places which present a suitable contrast of shelter and exposure. The first three lines of enquiry, so far as my limited opportunities enable me to judge, all seem to lead to a belief in an influence on course; but it is on results obtained by the last-mentioned method that I have chiefly ventured to lay stress.

Amongst the female cases tabulated for me, by my friend Dr. Harper, in Barnstaple Rural District, there were 153 in which the duration of the illness was stated.¹² From 1860 to 1884, a number of these cases occurred both in sheltered and exposed parishes. After 1884, very few cases occurred in sheltered parishes, but in the exposed parishes it was possible to compare a relatively windless and very dry period with relatively wet and windy periods. Cases under 5 years old had been excluded from our former work and now cases

dying at 50 and upwards were also omitted, because they tended to exceptional chronicity. Cases lasting 9 months or less were called "short," those lasting 15 months or more were called "long." It was found that, during the period 1860 to 1884, the parishes exposed to S.W., W. and N.W. winds had a rather higher proportion of "short" cases and a far smaller proportion of "long" cases (less by two-thirds) than the parishes sheltered from all three; and that in the exposed parishes the wetter and windier years showed a rather higher proportion of "short" cases, and a much smaller proportion of "long" cases (less by more than a half), than did the drier and less windy period.

Similar contrasts were supplied by two other areas.¹³ In both of these, cases dying at 50 and upwards were excluded as above, in Barnstaple District, and so also were cases dying at 10 and under, because here these were noticed to tend to exceptional acuteness. In Okehampton Rural District, during the 50 years 1860 to 1909, the parishes which were exposed to both W. and S.W. winds, had a much higher proportion of cases lasting less than one year, and a decidedly smaller proportion of cases lasting two years and over, than the parishes sheltered from both winds. In the parishes round Budleigh Salterton, during the 45 years 1866 to 1910, the parishes exposed to S.W., W., or N.W. winds had a much higher proportion of cases lasting less than 2 years, and a much smaller proportion of cases lasting 2 years and over, than the parishes sheltered from all three winds.

My reasons for using different periods and standards of duration in these different areas are explained in the original papers. The objection, that recorded durations cannot be relied on implicitly, is met by the great improbability that in three different areas the errors would all tell in exactly the same direction.

10. EFFECT ON OTHER FORMS OF HUMAN TUBERCULOSIS.

The considerable dependence of other forms of human tuberculosis on infection by milk may be expected to interfere with the effects of other factors in their ætiology. But indications are not wanting that strong prevalent rain-bearing winds do exert some influence upon them. Thus, although

in the English counties, the orders of prevalence of phthisis and of other forms of tuberculosis by no means exactly correspond, yet, broadly speaking, those counties in which phthisis is commonest have most deaths from other forms of tubercle³; so that, if the counties are arranged in ascending order of their female phthisis death-rates (1891-1900), and if the averages of their female death-rates from other tuberculous diseases are calculated for the five successive groups of nine counties each, we obtain on the whole an ascending series of death-rates .45, .42, .45, .51, and .59 per 1,000.

II.—EFFECT ON BOVINE TUBERCULOUS MASTITIS.

In the spring of 1910 Professor Delépine of Manchester read a very valuable paper¹⁵ dealing with the distribution of bovine tuberculosis amongst the farms supplying Manchester with milk. 1,524 farms, scattered over an area of nearly 5,000 square miles, were carefully investigated and mapped, so that it was possible to identify them on a 2-miles-to-the-inch Ordnance Survey map tinted to indicate altitudes. His work afforded a unique opportunity of investigating the influence of rain-bearing winds on the prevalence of bovine tuberculosis.¹⁴

The area discussed by him is divided by the Pennine Chain into a western region of level or undulating country, reaching from North Lancashire into North Shropshire, and an eastern region of hills and valleys, stretching across into Yorkshire, Derbyshire, and Staffordshire. The western region is swept freely by the S.W., W., and N.W. winds down to about the latitude of Chester; there the Welsh mountains begin to afford some protection from S.W. and W., and still further south, about the latitude of Ellesmere, they also give some shelter from the N.W. The eastern region is predominantly a region of shelter from all three winds, most of the farms lying in valleys which afford fairly effectual protection, although it must not be supposed that all are thus protected, some farms standing high in apparently wind-swept situations. Altogether the contrast between these western and eastern regions, in respect of shelter and exposure, is a very marked one.

The comparison between the farms, in shelter and exposure

respectively, was simplified by dividing the whole area into districts, each of which could be dealt with separately. Other factors which might have been supposed likely to affect the result were readily eliminated; soil, if it interfered at all, did so only by lessening the contrast between shelter and exposure, not by increasing it; altitude here, as elsewhere, had no discoverable influence.

A general comparison of the western region with the eastern showed a much greater proportion of tuberculous farms in the former, and a comparison of separate western and eastern districts of corresponding latitudes made this contrast even more conspicuous, the western districts having without exception a higher percentage of infected farms than the corresponding eastern districts. Again, when the western and eastern regions were further compared after the omission of certain districts, whose inclusion seemed to render the comparison unfair, the contrast became even more marked, the western having twice the proportion of tuberculous farms that the eastern had. Finally, when only evidently well-exposed farms were compared with only evidently well-sheltered farms, the exposed were found to have a percentage of tuberculous more than four times as great as the sheltered.

12.—THE FAILURE OF OBJECTIONS.

The history of the work has been one of the successive meeting of objections. At the present moment, so far as I can discover, none survive. Their failure forms a useful piece of negative evidence.

CONCLUSIONS.

I imagine it will be held by those who have carefully followed this evidence, particularly if they have referred to the original publications, that the following conclusions are inevitable.

Proved.

That populations exposed to strong, prevalent, rain-bearing winds tend to suffer considerably more from pul-

Probable.

That exposure to strong, prevalent, rain-bearing winds tends to :—

i. Affect appreciably the

Proved.

monary tuberculosis than populations sheltered from them.

Probable.

course of existing cases of phthisis;

ii. Affect considerably the prevalence of bovine tuberculosis; and

iii. Affect somewhat the prevalence of other forms of human tuberculosis besides pulmonary.

PRACTICAL DEDUCTIONS.

Hence naturally follow these practical deductions:—

- A.—It is *imperative*, in choosing a place of residence for cured cases of pulmonary tuberculosis or for persons of pronounced tubercular family history, to take into account its wind-exposures.
- B.—It is *imperative*, in investigating any influence bearing on the prevalence of pulmonary tuberculosis and possibly of other forms of tuberculosis, first to recognize and eliminate the influence of strong, prevalent, rain-bearing winds.
- C.—It will be *wise*, in choosing a site for a tuberculosis-sanatorium, to take the local wind-exposures carefully into account.
- D.—It will be *wise*, in examining farms for cases of bovine tuberculosis, to examine particularly those which are fully exposed to these winds.

REFERENCES.

- ¹ *Med. Chir. Transac.*, Vol. 84, 1900, and *B.M.J.*, 1901, Vol. I., p. 69.
² *Transac., Brit. Congress of Tuberculosis*, 1902, Vol. II., p. 524. ³ *The Influence of strong prevalent rain-bearing winds on the Prevalence of Phthisis*. Lewis: London, 1910. ⁴ *B.M.J.*, 1906, Vol. II., p. 1165. ⁵ *B.M.J.*, 1905, Vol. I., p. 62.
⁶ *B.M.J.*, 1909, Vol. II. ⁷ *Lancet*, 1905, Vol. I., pp. 10 and 77. ⁸ *Handbuch der Klimatologie*, Vol. I., p. 292. ⁹ *Report of the Medical Officer of the Prison Council*, 1867, p. 110. ¹⁰ *Geographical Pathology*, 1892, Vol. I., p. 128. ¹¹ *Supplement to the 55th Annual Report of the Registrar-General*, Part II., 1897. ¹² *B.M.J.*, 1912, Vol. I., p. 291. ¹³ *B.M.J.*, 1912, Vol. I., p. 773. ¹⁴ *B.M.J.*, 1911, Vol. I., p. 482.
¹⁵ *Proc. Roy. Soc. Med., Epidem. Sect.*, April 22, 1910.



TUBERCULOSIS IN IRELAND.

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HISTORY OF TUBERCULOSIS IN IRELAND.

TUBERCULOSIS, especially tuberculosis of the lungs, has been from time immemorial in Ireland "the most terrible of all the ministers of death."¹ This is evident from the classical Irish names for the disease: *Seirglighe*, decay; *Seirgean as*, shrinking of one's self; *Cnaoidh*, wa-ting; *Ethige*, pulmonary consumption (West); *Creacht an Sgamhain*, ulcer of lung.

In the *Report of the Census of Ireland Commissioners for 1841* we read: "Consumption—by far the most fatal affection to which the inhabitants of this country are subject—is reported to have destroyed 135,590 of the population of those families from whom the returns were received on the 6th of June, 1841, being to the deaths from all causes, 1 in 8·75; to those from the class of diseases of the respiratory and circulating organs, 1 in 1·31; to the total number of deaths from epidemic, endemic, and contagious diseases, as 100 to 281·17; and to fever alone as 100 to 82·65."

The writer of this quotation was Dr. William Robert Wilde, afterwards Sir William Wilde, the author of the masterly analysis of the Tables of Deaths contained in Part V. of Volume I. of *The Census of Ireland for the year 1851*. At page 447 of that volume Wilde writes: "We have now to report upon as many as 153,098 deaths from this cause (consumption), the sexes being 96·7 males to 100 females; of these, 138,752 were received upon the 'A. Form' or household schedule, viz., 107,383 from the rural, and 31,369 from the civic districts, the latter localities affording in proportion to their population a greater number of deaths from this cause than the former. 2,272 deaths from phthisis were returned from hospitals, and 12,074 from workhouses, being,

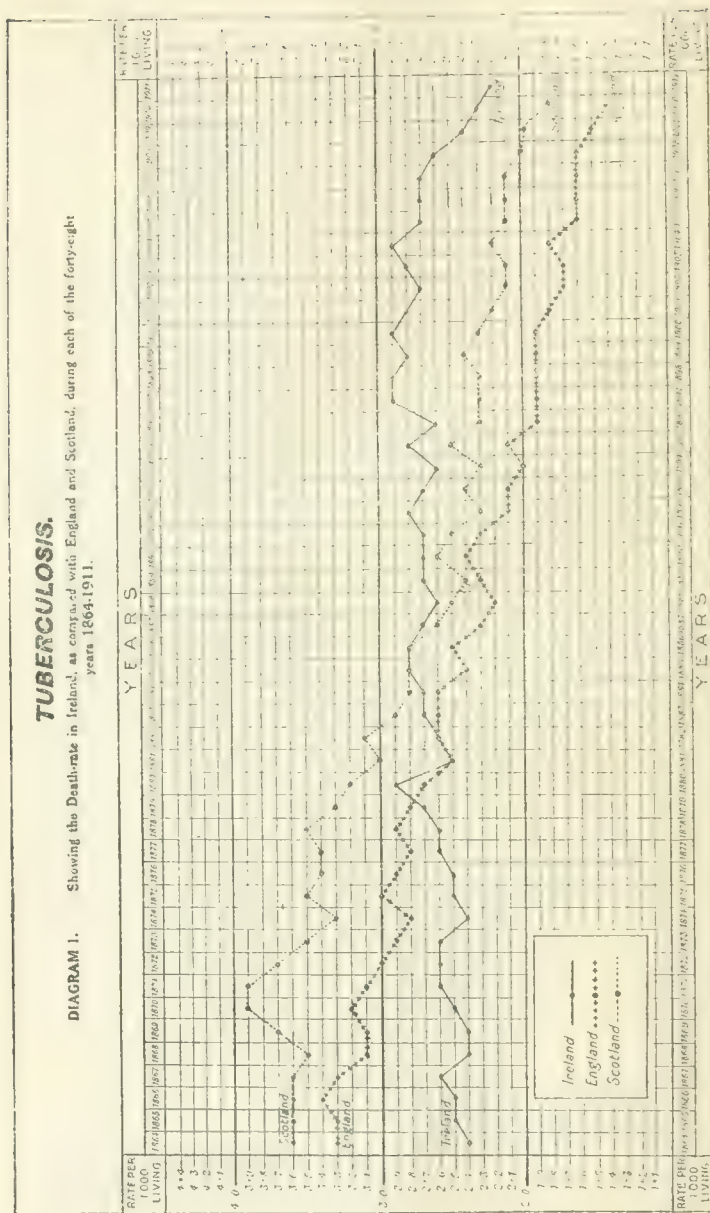
¹ Cf. Lord Macaulay's account of the death of Queen Mary from smallpox in 1691.

with the exception of those deaths from diseases classed under 'Infirmity, Debility, and Old Age,' the fifth most fatal affection in that class of institutions. During the years from 1842 to 1845 both inclusive, the average annual number of deaths from consumption was 10,919; in 1846 we find the number increased to 15,792; and in the three following years, when the general mortality reached an almost unparalleled height in Ireland, the annual average deaths from consumption rose to 21,975; but in 1850 the returns for this disease fell to 19,755. In proportion to the total deaths from all causes, those from consumption were 1 in 8·8 (or very nearly that returned for 1841); and in proportion to all specified causes, 1 in 8·0; varying in the Provinces as Leinster, 1 in 6·4; Munster, 1 in 10·2; Ulster, 1 in 6·4; and Connaught, 1 in 12."

The Census Commissioners of 1851 made extensive inquiries into the seaboard and inland mortality from "consumption." They found that, while the ratio of deaths from this cause was to the general mortality as 1 to 7·14 for the country at large (exclusive of deaths in workhouses, hospitals and public institutions), the difference between the sea-board and the inland baronies was 1 to 6·82 in the former, and 1 to 7·70 in the latter. This would seem to indicate that the coast-line predisposed to consumption, but the final conclusion to which the Commissioners came was that the coast-line of country was less productive of diseases of the respiratory organs than the inland districts, and that the western coast of Ireland exhibits less mortality from diseases of the chest than other parts of this country. The apparent discrepancy is solved when we remember that the large cities—Dublin, Belfast, and Cork—are all situated on or near the coast, and in them pulmonary tuberculosis was in 1851, as in 1911, more fatal than in any other parts of Ireland. The statistics for 1911 which bear out this explanation will be referred to later.

Registration of births, deaths, and marriages was introduced in England so long ago as the year 1836 by the Registration Act of 6 & 7 William IV., Chapter 86. It was not until January 1st, 1864, that births and deaths were registered in Ireland under the Registration of Births and Deaths

DIAGRAM I.



(Ireland) Act, 1863 (26 Victoria, Chapter 11). Reliable statistics as to the death-toll exacted by tuberculosis in Ireland, therefore, do not date back further than the year 1864. Still, a period of 48 years is sufficiently long to justify the statistician in drawing conclusions.

In the *Forty-Eighth Annual Report on the Vital Statistics of Ireland*, that for the year 1911, the first having been prepared for 1864—the Registrar-General, Sir William J. Thompson, M.D., points out that, since the year 1904, in which the recorded death-rate from all forms of tuberculosis was 2·9 per 1,000 of the population, estimated to the middle of the year, the rate has fallen in 1911 to 2·2 per 1,000, which is the lowest rate as yet presented for Ireland. In 1910, the death-rate was 2·3, and the reduction to 2·2 in 1911 means a saving of 393 lives. Tuberculosis in general was still, in 1911, first among the causes of death, its victims numbering 9,623, of whom 4,731 were males and 4,892 were females.

In the annexed Diagram I., which, with others, I am enabled to reproduce through the kindness of the Registrar-General and by the courtesy of the Controller of His Majesty's Stationery Office, the death-rates from tuberculosis in Ireland, as compared with those in England and Scotland, are shown for each of the forty-eight years, 1864 to 1911.

At the beginning of the period, the condition of England and Scotland in regard to tuberculosis was much less satisfactory than that of Ireland. At its close, the relative positions of the three divisions of the United Kingdom had undergone a change inasmuch as Ireland now occupied the least favourable place.

In Scotland, the death-rate from all forms of tuberculosis per 1,000 of the living population was 3·6 in 1864, rising to 3·9 in 1870 and 1871. After the last-named year, a marked decline set in, proceeding with slight annual irregularities to 1910 (the last year for which figures are available), when the death-rate was only 1·8 per 1,000.

In England, the tuberculosis death-rate was 3·3 in 1864, rising to 3·4 in 1866, from which year there has been a tolerably steady decrease to 1·4 in 1910. The death-rate

has therefore fallen by nearly 59 per cent. in 44 years.

Ireland tells a different and less flattering tale. Starting in 1864 with a tuberculosis death-rate of 2·4 per 1,000 of the population, this country developed a rate of 2·9 in 1879—an extremely cold and wet year—and again in 1897, 1898, 1900, and so recently as 1904. From that time there has been a marked decrease to 2·7 in 1905 and the two following years, 2·6 in 1908, 2·4 in 1909, as in 1864, 2·3 in 1910, and 2·2 in 1911—this last, happily, the lowest figure in the long series of 48 years.

The English death rate from tuberculosis fell permanently below the Irish in 1883, having been persistently above it in each year from 1864 to 1879, inclusive. The Scottish tuberculosis death-rate fell permanently below the Irish in 1887, having been persistently above it from 1864 to 1884, inclusive.

In his Presidential Address to the Dublin Sanitary Association on February 3, 1887, the late Dr. T. W. Grimshaw, Registrar-General for Ireland, speaking on the death-rate of Dublin, said :—"Consumption is the principal cause of death in the constitutional class of diseases: the average annual death-rate from this disease per 10,000 of the population of the Dublin District during the decade 1865-74 was 31·7; during the decade 1875-84 it was 33·2, or 1·5 per 10,000 more."

Speaking five years later from the Presidential Chair of the same Association on March 30, 1892, Mr. Frederic W. Pim, observed : "Besides the zymotic diseases, which are ordinarily spoken of as preventable, there are several others which, if not wholly preventable, are—at least to a considerable extent—amenable to preventive measures, and may, by means within our reach, be appreciably mitigated. Amongst these we may, unhesitatingly, reckon phthisis, or pulmonary consumption, which in 1890 carried off 1,292 persons (in Dublin), whilst the deaths from all the recognized zymotic diseases combined were only 1,019."

Mr. Pim quoted from a paper on "Special Causes of Mortality," by Dr. Ogle, F.R.C.P., then Superintendent of Statistics to the General Register Office for England, in which that able statistician and sanitarian showed that, whilst the comparative

mortality from phthisis ranges only from 52 to 62 among farmers, fishermen, gardeners, and agricultural labourers, who live an open-air life. the rate among tailors is 144 and among printers 233. These classes, especially the latter, habitually work in confined, crowded, ill-ventilated, and often overheated rooms. He proceeded: "I note these facts as indicating clearly one direction in which measures for the prevention of pulmonary consumption may be attempted with fair prospect of success. They seem to point, above all things, to the necessity for a plentiful supply of fresh and pure air."

On July 31, 1896, I read a paper, entitled "Tuberculosis: its Prevention and Cure," before the Section of Medicine at the Carlisle meeting of the British Medical Association. In that communication, I showed that the malign influence of town life on the fatality from tuberculosis is clearly brought out by a comparison of the statistics relating to Dublin and Belfast with those which refer to Ireland at large.

In 1887, Dr. Grimshaw, Registrar-General for Ireland, read before the State Medicine Section of the Royal Academy of Medicine in Ireland a paper on "The Prevalence and Distribution of Phthisis and other Diseases of the Respiratory Organs in Ireland."¹ He showed that in the decennial period, 1871-1880, pulmonary consumption, considered as a single disease, was the most potent cause of death in Ireland, constituting, as it did, the cause of *more than one-tenth* of all the deaths registered during the decade. The exact figures were: deaths from phthisis, 103,528; from all causes, 906,745. The death-rate from phthisis throughout Ireland was 19·6 per 10,000 of the population annually. In the town districts, with a population of 10,000 and upwards, the rate rose to 34·7. The annual death-rate per 10,000 from pulmonary consumption in the decade ranged from 4·8 in the storm-swept wilds of Belmullet Union, co. Mayo, to 33·4 in the North Dublin Union, and to 38·2 in Belfast, with its flax spinning wheels (*dust*), and water-logged subsoil (*damp*). Across a map of Ireland illustrating his paper, Dr. Grimshaw drew a line from Londonderry in the extreme north to Skibbereen in the county Cork, thus dividing the whole

¹ *Transactions Acad. of Med. in Ireland*, Vol. V., 1887, p. 314.

MORTALITY FROM TUBERCULOSIS.

Rate per 1,000 of the Population, according to the Census of 1911 (Parliamentary Abstract), represented by the deaths from

ALL FORMS OF TUBERCULOSIS

registered in each County of Ireland during the year 1911.



island into a western and an eastern half. The western division represents what may be called the poverty-stricken portion of the country; the eastern is more well-to-do, more populous, and represents a higher grade of civilization, because of the large towns and the urban population which it contains. Pulmonary consumption prevailed in the eastern, but fell below the average in the western districts. And so it is at the present day.

The accompanying map, reproduced from the *Annual Report of the Registrar-General for Ireland for 1911*, by permission of the Controller of His Majesty's Stationery Office, shows the death-rate per 1,000 of the population, according to the Census of 1911 (Parliamentary Abstract), represented by the deaths from all forms of tuberculosis registered in each of the thirty-two counties of Ireland during the year 1911. It will be seen that the death-rates range from 1·2 in Leitrim and Roscommon, 1·3 in Cavan and the North Riding of Tipperary, and 1·4 in Donegal and Fermanagh, to 2·5 in Cork and Kildare, 2·8 in Antrim, and no less than 3·4 in Dublin. The counties on the west and south-west coasts occupy an intermediate position, Galway with a death-rate of 1·6 per 1,000, Kerry, Clare, and Mayo with one of 1·7, and Sligo with one of 1·9. These relatively high figures for the coastal counties seem to bear out the views expressed by Dr. William Gordon, of Exeter, as to the unfavourable influence of strong, prevalent, rain-bearing winds on the prevalence of phthisis. His views are set forth in various communications published in and since the year 1910, and in this Special Number of THE PRACTITIONER. By such winds the south-western and western shores of Ireland are swept through nine months of the year, on an average.

Objection may be made to the use of this map on the ground that it deals with all forms of tuberculosis and not with pulmonary tuberculosis alone. But the proportion which the latter bears to the former is easily ascertained.

PRESENT DAY STATISTICS.

In the following Table, taken from the Irish Registrar-General's Report for 1911, the numbers and death-rates per 1,000 of the population for all forms of tuberculous disease

and for pulmonary tuberculosis are given for the years 1901-1911, with annual averages for these years:—

TABLE SHOWING THE NUMBER OF DEATHS FROM ALL FORMS OF TUBERCULOUS DISEASE REGISTERED IN IRELAND DURING THE YEARS 1901-1911, WITH THE NUMBER OF DEATHS FROM PULMONARY TUBERCULOSIS AND THE RESPECTIVE RATES PER 1,000 OF THE POPULATION REPRESENTED THEREBY.

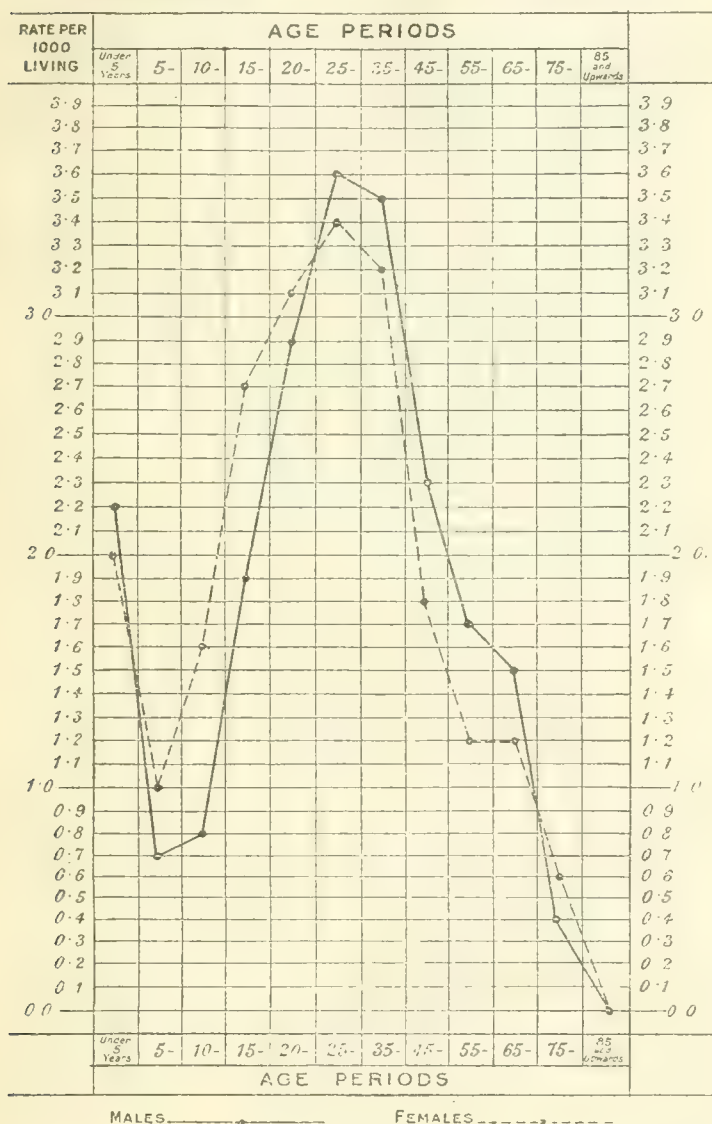
Years.	Deaths from all Forms of Tuberculous Diseases.		Deaths from Pulmonary Tuberculosis	
	Number.	Rate per 1,000.	Number.	Rate per 1,000.
1901 - - -	12,335	2.8	6,549	2.1
1902 - - -	11,837	2.7	6,406	2.1
1903 - - -	12,180	2.8	6,559	2.2
1904 - - -	12,994	2.9	6,833	2.2
1905 - - -	11,882	2.7	9,216	2.1
1906 - - -	11,736	2.7	8,933	2.0
1907 - - -	11,474	2.7	8,828	2.0
1908 - - -	11,215	2.6	8,511	1.9
1909 - - -	10,304	2.4	8,031	1.8
1910 - - -	10,016	2.3	7,527	1.7
Averages, 1901-1910 -	11,927	2.7	8,941	2.0
1911 - - -	9,125	2.2	7,584	1.7

It may be seen that during the above period the high death-rate from all forms of tuberculous disease of 2.9 per 1,000 was reached in the year 1904, but that since that year there has been a gradual decline to 2.2 per 1,000 for all forms of tuberculous disease and to 1.7 per 1,000 for pulmonary tuberculosis.

Pulmonary Tuberculosis.—There is an apparent increase in the year 1911 in the number of deaths which come in under this title on account of a change in classification by which deaths returned as from “tuberculosis, not otherwise defined” are classified now under this title. Such deaths in previous years were assigned to general tuberculosis. These deaths in 1911 numbered 252, and the total, including this figure, amounted to 7,584 against 7,527 in the year 1910, and an

DIAGRAM II.

Showing the Proportion of Deaths from All Forms of Tuberculous Disease of Males and Females registered in Ireland at each age-period, per 1,000 living at those ages, during the year 1911.



average for the 10 years 1901-1910 of 8,941 deaths. Of the 7,584 deaths, 3,702 were of males and 3,882 were of females, the rates corresponding to the foregoing numbers being 1.70 and 1.77 per 1,000 of the respective populations.

The most heartrending feature in connection with tuberculosis is its fatal incidence on those age-periods which are well described as the prime of life. The curves of mortality in Diagram II. taken from the Irish Registrar-General's Report for 1911, illustrate this feature only too clearly. It is in the age periods from 15 to 45 years, and especially in those from 20 to 35 years, that tuberculosis in all its forms attacks and slays its victims in largest numbers. And so the flower of the manhood and womanhood of the country is cut down by the "Reaper whose name is Death."

In the following Table, taken from the same Report, the deaths and death-rates from pulmonary tuberculosis in 1911, are presented by sexes and age periods:—

Age Periods.	Deaths from Pulmonary Tuberculosis in Ireland.					
	Total of both Sexes.		Of Males.		Of Females.	
	Number.	Rate per 1,000.	Number.	Rate per 1,000.	Number.	Rate per 1,000.
0-5 years -	211	0.49	101	0.45	110	0.52
5-10 " -	107	0.24	42	0.19	65	0.30
10-15 " -	309	0.60	77	0.33	232	1.06
15-20 " -	859	1.85	350	1.50	509	2.21
20-25 " -	1,158	2.66	549	2.55	609	2.76
25-35 " -	2,066	3.21	1,037	3.26	1,029	3.16
35-45 " -	1,449	3.06	749	3.23	700	2.90
45-55 " -	751	1.85	406	2.11	345	1.62
55-65 " -	433	1.26	252	1.50	181	1.02
65-75 " -	209	1.12	126	1.32	83	0.09
75 and upwards	52	0.35	13	0.29	19	0.41
Total all ages -	7,584	1.73	3,702	1.70	3,882	1.77

From this Table, it appears that, while there is not much difference between the sexes in the total death-rate, in the

earlier age periods the female mortality is much greater than that of the male. After the 20-25 years age period, however, the male mortality rate considerably exceeds that of the female, with the exception of the period 75 years and upwards, when the female rate again exceeds the male rate.

Many years ago the late Dr. Grimshaw, when Registrar-General for Ireland, arranged the population of the Dublin Registration Area in the following four social classes:— (1) The professional and independent class; (2) the middle class; (3) the artisan class and petty shopkeepers; and (4) the general service class, including domestic servants, soldiers, policemen, postmen, prison warders, coachmen and car drivers, vanmen, hawkers, porters, labourers and such like.

Sir William J. Thompson, the present Registrar-General, includes in his Annual Report for 1911 an interesting table which gives information regarding the mortality from tuberculosis in that year among the several social classes above mentioned in the Dublin Registration Area, of which the population (estimated to the middle of 1912 is 400,865). From that Table it appears that amongst the professional classes the death-rate from all forms of tuberculosis in 1911 was 1·15 per 1,000 of the population according to the Census of 1901; in the middle class the death-rate was 2·35; in the third class it was 3·04; and in the general service class it was 3·56 per 1,000. Can any figures be more convincing as to the influence of social position for good or for evil on the mortality caused by tuberculosis?

HISTORY OF THE IRISH CRUSADE AGAINST TUBERCULOSIS.

Having now sketched the history of tuberculosis in Ireland, and submitted the most recent statistical facts as to its present-day ravages in this country, it remains for me to state what steps have been, and are being, taken to stay the plague, to which we may well apply the memorable words of King Edward VII.—“If preventable, why not prevented?”

From the year 1892, the subject of “Tuberculosis: its prevalence and prevention,” received attention at the hands of the Dublin Sanitary Association in its Annual Reports, and in the Annual Addresses delivered by its successive presidents. A valuable report on the Prevention of Tuberculosis also forms

Appendix I. of the Report of the Council of the Association for the year ended December 31, 1897. Recognizing the extreme importance of the matter, the Council sent copies of that Report to all the urban and rural sanitary authorities of Ireland.

Another important step was the founding of the Royal National Hospital for Consumption for Ireland in the open country, near Newcastle, co. Wicklow, in the year 1896. The institution was opened on the 19th of March in that year, by the Marchioness of Zetland, wife of the Viceroy. It was established for the treatment of poor patients in the incipient or early stage of the pulmonary form of the disease. Patients of both sexes are admitted from all parts of Ireland without religious distinction. The treatment adopted is that of the open air system, the patients being as much as possible out of doors. Since the opening of the hospital the number of patients treated, including 90 patients in hospital on December 31, 1911, has been 4,212. The normal length of stay in the hospital is 10 weeks. The results of the treatment, which are of a very satisfactory and encouraging character, are tabulated in the medical reports, which will be found appended to the Annual Reports for each year.

Thirdly, a branch of the then recently inaugurated National Association for the Prevention of Tuberculosis was established in Dublin early in the year 1899, under the presidency of His Excellency, Earl Cadogan, K.G., at that time Lord Lieutenant of Ireland. This branch did good service through many years in widely disseminating literature bearing on the infectiousness and dangers of tuberculosis and methods of prevention.

Lastly, in 1907, Her Excellency the Countess of Aberdeen founded the Women's National Health Association of Ireland, the objects of which are :—1. To arouse public opinion, and especially that of the women of Ireland, to a sense of responsibility regarding the public health. 2. To spread the knowledge of what may be done in every home, and by every householder, to guard against disease, and to eradicate it when it appears. 3. To promote the upbringing of a healthy and vigorous race.

The "disease," to combat which has been the great aim of the Association, is tuberculosis. Lady Aberdeen's personal and

untiring efforts, moreover, have called into existence in Dublin the Collier Memorial Dispensary for Prevention of Tuberculosis, and the Allan A. Ryan Home Hospital for Consumption on the south wall of Dublin Harbour.

THE HOSPITAL TREATMENT OF TUBERCULOSIS.

The hospital treatment of tuberculosis is an anxious question, not easily solved. The requirements would seem to be :—

1. Consumption hospitals, or sanatoriums, in which the pulmonary form of the disease could be treated in its earlier and more hopeful stages.
2. Special isolated consumption wards in existing general hospitals, into which tuberculosis, and that disease alone, should be received. Abundant air space, with free access of air and sunshine, should be an indispensable requirement.
3. Refuges for patients far advanced in, or dying of, consumption. The German name for such an institution is very expressive, "Friedensheim," or "Home of Peace." Dublin possesses three institutions of this sadly pathetic character—the Royal Hospital for Incurables, founded in 1740, standing in extensive grounds in the Pembroke township, a healthy suburb; Our Lady's Hospice for the Dying, at Harold's Cross, in the Rathmines township, another large and healthy suburb; and the Rest for the Dying, in the city itself.
4. Home hospital treatment, rendered possible under the provisions of the Tuberculosis Prevention (Ireland) Act, 1908, if adopted by any Sanitary Authority with the sanction of the County Council concerned.

LEGISLATION AGAINST TUBERCULOSIS.

I.—THE TUBERCULOSIS PREVENTION (IRELAND) ACT, 1908, AND ITS FAILURE.

This Act came into force on July 1, 1909. Unfortunately, it is a permissive, not a compulsory, Act, and to this is due the fact that three years later its provisions have been adopted in only 22 out of the 96 urban districts, and in only 19 out of the 215 rural districts, into which the whole of Ireland is divided for public health and local government purposes.

Part I. of the Act deals with the notification of tuberculosis and the disinfection of premises and articles likely to retain the infection of this fell disease. This part of the Act takes effect only in the districts of those sanitary authorities, whether urban or rural, which decide to adopt its provisions. In other words, it is left to the discretion of each sanitary authority to avail itself of the principle of compulsory notification of tuberculosis.

Furthermore, the adoption of Part I. of the Act does not lie entirely in the discretion of the local sanitary authority, save in the case of the six county boroughs in Ireland—namely, Dublin, Belfast, Londonderry, Cork, Waterford, and Limerick—the urban sanitary authority of which is, in each instance, also a county council in itself. In all other cases, the adoption of this part of the Act by a sanitary authority is subject to the approval of the council of the county in which the district of such authority is situated. This provision introduces an element of possible conflict of opinion between the legally constituted sanitary authorities of the county and the county councils (outside the six county boroughs), bodies endowed and entrusted with no sanitary powers by the Local Government (Ireland) Act, of 1898.

The permissive nature of the first part of the Tuberculosis Prevention Act—the really essential portion of the measure—to my mind, dealt a fatal blow to its power as an effective preventive agency.

Worse still was the provision, contained in Section 1, Subsection 2 of the Act, whereby the duty of determining the forms and stages of tuberculosis to which, and the circumstances in which, the principles of compulsory notification shall apply, was entrusted to the Local Government Board for Ireland *after consulting with the President of the Royal College of Physicians of Ireland, and the President of the Royal College of Surgeons in Ireland*. The Presidents were thus constituted an “Advisory Committee,” *on paper*.

In the Bill as originally drafted, presented to Parliament by Mr. Birrell, Chief Secretary to the Lord Lieutenant of Ireland, and ordered by the House of Commons to be printed, June 3, 1908, the duty of prescribing the forms and stages of tuberculosis to which, and the circumstances in which,

notification of the disease should apply was entrusted to the Local Government Board alone.

When the Bill reappeared in the House of Commons five months later (November 4, 1908) as amended by Standing Committee A., subclause (2) of clause 1, read as follows:—

“(2) The Local Government Board, after consulting with the Irish branch of the General Council of Medical Education and Registration of the United Kingdom, shall from time to time by order prescribe the forms and stages of tuberculosis to which, and the circumstances in which, this section shall apply, but no forms of tuberculosis shall be so prescribed save such as by reason of infective discharges are liable to communicate the disease to other persons.”

The proposal was thus to constitute the Irish Branch Council, for the purposes of the Bill an Advisory Committee to the Irish Local Government Board. When this matter was brought to the notice of the Irish Branch Medical Council that body reported it to the General Medical Council, which in turn represented to the Government the willingness of the Branch Council to serve as an Advisory Committee, but at the same time explained that the Branch Council had no funds at its disposal to defray the necessary expenses.

Nothing more was heard of the proposal, but in a subsequent draft of the Bill the provision which was afterwards enacted appeared without any reference whatever having been made on the subject, either to one or other of the Irish Royal Colleges, or what was still more extraordinary to one or other of the then existing Presidents of those Colleges, one of whom was a distinguished obstetrician and gynaecologist, and the other an equally distinguished surgeon.

In the end, it is an open secret that the Presidents were not asked in the first instance what their views were—that is to say, they were not consulted in the ordinary sense, but were merely asked to approve the forms and stages of tuberculosis which the Local Government Board for Ireland “determined” should be notified.

On June 3, 1909, the Local Government Board issued an “Order” prescribing the forms and stages of tuberculosis to which, and the circumstances in which, section 1 of the Tuberculosis Prevention (Ireland) Act should apply. This

"Order" came into operation on July 1, 1909. It prescribed that in every district to which Part I. of the Act extends, section 1 of the Act shall apply to the form of tuberculosis known as "Tuberculosis of the Lung," at any stage at which the sputum discharged by the person suffering, is, in the opinion of the medical practitioner attending on such person, liable to communicate the disease to other persons. So far so good, but it was further provided by the Order that the section of the Act in question shall apply only in the following circumstances, that is to say, where the person suffering:—

"(1) Habitually sleeps or works in the same room as any other person or persons not so suffering; or

"(2) Is employed or engaged in handling, preparing, or distributing milk, meat, or any other article of human food intended for sale to the public."

This extreme limitation of the circumstances, under which notification is to be made, renders the procedure of little or no value for statistical purposes, or even for prevention of tuberculosis. Taking the county boroughs of Dublin and Belfast, we find that in the year ended March 31, 1911, 852 cases of tuberculosis were notified in Dublin, and 832 in Belfast. The deaths registered as due to that same disease were 791 in Dublin and 818 in Belfast. These figures show that death registration gives practically as full information regarding the prevalence of tuberculosis as that afforded by notification under the Order of the Local Government Board.

Unlike Part I., the remaining parts of the Tuberculosis Prevention (Ireland) Act require no formal adoption by any county, urban, or rural district council.

Part II. of the Act deals with the provision by any county council or county borough of hospitals—a term which is held to include "sanatoriums"—and dispensaries for the treatment of inhabitants of the county or county borough suffering from tuberculosis *of any kind*.

Part III. of the Act contains many useful sanitary provisions of which a "local authority" may avail itself, if it thinks fit to do so. "Local authority" means a "sanitary authority"—that is, an urban or rural district council. Arrangements may be made for the delivery of public lectures,

the distribution of pamphlets relating to tuberculosis, and the providing of drugs and appliances. County Councils are also empowered to appoint bacteriologists for their respective counties, and any urban or rural district council may employ a veterinary surgeon for the examination and inspection of meat exposed for sale or stored for purposes of sale. And, lastly, the Local Government Board are given power to make, on the application of any urban district council, an order authorizing that council to exercise all or any of the powers of supervision in relation to dairies *outside* their district, which the board previously could authorize such a council to exercise in respect to dairies *within* their district.

Part IV. of the Act provides a machinery for the payment of expenses incurred under the Act, the method whereby offences under the measure may be prosecuted, the necessary definitions of terms therein used, and the mode of citation of the Act and its extent.

Has the Tuberculosis Prevention (Ireland) Act, 1908, proved a successful piece of legislation? Have its provisions in any way materially aided the crusade against tuberculosis? It is with regret, that I am constrained to answer these questions in the negative.

In order to obtain authentic and authoritative information as to the working of the Act, I wrote to the Local Government Board for Ireland. In a letter dated August 27th, 1912, the secretary of that body courteously informed me, by direction of the Board, that Part I. of the Act up to the present has been adopted by 22 urban and 19 rural districts in Ireland. Be it remembered that there are 96 urban and 215 rural districts in the country.

"Shortly after the passing of the Act, in one or two instances, county councils either withheld or indefinitely deferred their approval of proposals of sanitary authorities to adopt the system of notification, but at the present time a number of county councils, in dealing with arrangements connected with the National Insurance Act and the administration of sanatorium benefit, have recommended the sanitary authorities within their respective counties to put Part I. in force.

"Until recently but little action had been taken by county

councils in pursuance of Part II., but at present schemes for the establishment of dispensaries are in course of preparation in nearly every country. The question of the provision of sanatorium accommodation either in institutions established by county councils or under agreements with the managing bodies of existing institutions is also receiving general attention.

"The power to provide lectures, etc., has been availed of in a few instances, but with the prominence which the subject of tuberculosis has obtained by other means, there is less need for such educational measures on the part of a sanitary authority than was formerly the case.

"County bacteriologists have been appointed for four counties, and veterinary surgeons for the inspection of meat in a small number of sanitary districts.

"Many sanitary authorities have exercised their powers of slaughtering milch cows affected with tuberculosis.

"An extensive enquiry was recently held in regard to an application of the Belfast Corporation for powers of supervision over outside sources of the milk supply of that county borough. The matter is still under consideration."

I have quoted the *ipsissima verba* of this letter in order that my readers may judge for themselves whether this particular Act of Parliament, placed on the Statute Book nearly four years ago, has proved a success or otherwise, even in the opinion of the supreme sanitary authority of Ireland.

But hear the Local Government Board for Ireland further on this matter. In their Annual Report for 1912 the following stereotyped paragraph occurs at page xxxi:—"It is to be hoped that, before long, steps will be taken to introduce the compulsory notification of tuberculosis in all the larger urban districts. Such a course is specially desirable in the county boroughs of Cork and Waterford, where the incidence of phthisis is particularly heavy." An identical paragraph was inserted in the Annual Reports of the Board for 1910 (page xxxi) and 1911 (page xxxix).

But, further, appended to this statement in each of the last three years, is a summary of the notifications of tuberculosis in the county boroughs of Dublin and Belfast. The

figures are instructive :—

Dublin County Borough.

October 1, 1909—March 31, 1910 = 588

Year ended March 31, 1911 = 852

Year ended March 31, 1912 = 541

Belfast County Borough.

November 2, 1909—April 2, 1910 = 497

Year ended March 31, 1911 = 832

Year ended March 31, 1912 = 551

“As compared with the preceding year [1911],” write the Board, “the total number of notifications has fallen off considerably in both county boroughs. We fear that this result cannot be ascribed to any equivalent decrease in the prevalence of pulmonary tuberculosis, but is to be attributed to the incomplete working of the system of notification.”—(*Annual Report*, 1912, page xxxii.)

Dr. Brian O'Brien, Medical Inspector of the Local Government Board, in his report to the Board on the public health of the district under his charge during the year ended March 31, 1912, sums up the case against the Tuberculosis Act in the following pregnant paragraphs. His district consists of the counties of Antrim, Down, Armagh, and Monaghan, and portion of the counties of Derry, Tyrone, Cavan, and Louth, and includes Belfast County Borough.

He writes : “Part I. of the Tuberculosis Prevention (Ireland) Act, 1908, has been adopted by many of the sanitary authorities in this district. The notifications made under this portion of the Act are relatively few in number, and are frequently made only when the disease is far advanced. The reasons given for the limited number of notifications and for the late period at which they are made are :—1st, That no provision has been made by the county councils to establish sanatoria under Part II. of the Act ; 2nd, the restrictions that have been laid down with regard to the condition of the disease and the circumstances of the patients ; 3rd, the unwillingness of the medical practitioners to notify cases early in the disease without having the diagnosis confirmed by a bacteriological examination of the sputum.

“This bacteriological examination has been rendered impossible for the reason that bacteriologists have not been generally appointed by county councils under Part III. of the Tuberculosis Prevention Act.”—(*Report*, 1912, pages 72

and 73.)

Truly a candid, if unconscious, admission that the Act has failed is made in these statements of a Medical Inspector of the Local Government Board.

Two sanatoriums have been established under the Act in four years—one by the Dublin Joint Hospital Board at Crookslings, in the Dublin Mountains; the other, at Streamhill, near Buttevant, co. Cork, by the Cork Joint Hospital Board. Besides these sanatoriums, the Corporation of Belfast have made an arrangement with the Forster Green Consumption Hospital for the use of 35 beds, with an option of any further beds which may be vacant, while the Belfast Board of Guardians have a fine sanatorium at Whiteabbey, co. Antrim, in which 265 beds are kept constantly occupied.—(*Report of the L.G.B. for Ireland, 1911, page 76.*)

II.—THE NATIONAL INSURANCE ACT, 1911.

In their Report for 1912 the Local Government Board point out that the provision of sanatorium accommodation and of other forms of treatment for persons affected with tuberculosis has assumed new importance in view of the enactment of the National Insurance Act, 1911. They believe that the parliamentary grant available under that Act will afford a valuable inducement to the establishment of special institutions for the care of tuberculous patients.

Under the National Insurance Act, additional functions have been entrusted to the Local Government Board, and in connection with the administration of "sanatorium benefit" it will now come within the province of the Board:—

- (a) To approve sanatoriums and other institutions for the treatment of tuberculosis under the management of persons or local authorities, other than Poor Law authorities.
- (b) To approve the manner of treatment, when such treatment is provided by persons or local authorities, other than Poor Law authorities, otherwise than in sanatoriums or other institutions, and to authorize local authorities to provide such treatment (including the appointment of officers for the purpose).

- (c) To distribute, with the consent of the Treasury, sums made available by Parliament for the provision of, or making grants in aid to, sanatoriums and other institutions for the treatment of tuberculosis.

Arrangements for carrying this portion of the Act into operation are in progress.

A PLEA FOR THE "HOME TREATMENT" OF TUBERCULOSIS.

To my mind, the powers indicated under (b) are all-important—far more important from the standpoint of Preventive Medicine than the establishment of "sanatoriums and other institutions." It is, undoubtedly, in the "home" that war must be waged with the tubercle bacillus and its deadly consequences. At the recent meeting of the British Medical Association in Liverpool, the Medical Sociology Section considered the whole question of tuberculosis. The general view expressed was that the scheme of providing sanatoriums, outlined in the National Insurance Act, under sections 16 (1) (b), would not effect the desired end. What was of primary importance was, not that tubercular patients should be sent to sanatoriums and then allowed to return to insanitary homes reeking with disease, but that dwelling-houses should be made sanitary and habitable.

Many years ago I was asked to visit a coachman, whom I found seriously ill, indeed in the last stage of pulmonary consumption, of which he died shortly afterwards. He and his family occupied one room in a tenement house in a decayed city street. The room was divided by wooden partitions into three cubicles. Of these, one was occupied by the patient and his wife, another by a grown-up son, and the third by two daughters whose subsequent history I do not know. The wall and floor near the patient's bed were besmirched with dried and moist and, no doubt, highly infectious sputa. Is it much wonder that the son and wife both contracted phthisis, which killed the former, and left the latter a living wreck to the present day?

Is not this a concrete instance of the crying need for a wide spread application of the domiciliary treatment of tuberculosis rendered feasible by the provisions of section 16 of the

National Insurance Act ?

"What," asks Dr. Leonard Hill,* "is the use of the State spending a million a year on sanatoriums and tuberculin dispensaries, when those very conditions of work continue which lessen the immunity and increase the infection of the workers?"

In conclusion, I venture to state my conviction that if the crusade against tuberculosis in Ireland is to succeed it must be conducted on the following lines :--

1. A compulsory extension of the principle of notification to all parts of the country and to all forms of the disease ;
2. The appointment of whole-time county medical superintendent officers of health, independent of local influences and responsible only to the Irish Local Government Board ;
3. An extension and development as to numbers of the system of district nurses ;
4. The appointment of trained and qualified female sanitary inspectors throughout the country ;
5. Full effect to be given to domiciliary medical attendance in all cases of tuberculosis, for which accommodation cannot be found in hospitals, sanatoriums, and such like institutions ; and
6. Perseverance in efforts which have been, and are being, made to instruct the people at large as to the rules of life which must be obeyed if the deadly poison of tuberculosis is to be resisted successfully.

"Isolation hospitals, sputum-pots, and anti-spitting regulations will not stamp out tuberculosis," writes Dr. Hill in a subsequent part of his able and instructive address. He adds : "I believe that the conditions of exhausting work and amusements in confined and overheated atmospheres, together with ill-regulated feeding, determine largely whether the infection, which almost none can escape, become serious or not."

These are wise words, fit to be printed in letters of gold.

* An address on the "Influence of Muscular Exercise and Open Air on the Bodily Functions," delivered before the Physiological Section of the British Association at Dundee, September, 1912. (*Brit. Med. Journal*, September 14, 1912, p. 601)

ON THE EDUCATION OF THE PUBLIC IN RELATION TO THE PREVENTION OF TUBERCULOSIS.

By THEODORE DYKE ACLAND, M.A., M.D., F.R.C.P.

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the Chest, Brompton; and King Edward VII. Sanatorium.*

Now that the National Insurance Act has become law, there cannot be any question that every effort should be made to educate the public as to what can be done to prevent the spread of tuberculosis, and the share they must take if the measures adopted are to be brought to a successful issue.

Much has already been done—chiefly by voluntary organizations, such as the National Association for the Prevention of Consumption—to awaken the public conscience, and to create a demand that steps should be taken to deal with the problem of tuberculosis from an imperial rather than from a parochial point of view.

The compulsory notification of pulmonary tuberculosis, and the co-ordination of the means for combating the disease on a large scale with the aid of public funds—mainly independent of pre-existing voluntary associations—are measures of such far-reaching importance that they needed a public prepared to accept them, before they could be carried out with anything like success. It is not too much to say that it is chiefly through the pioneer work of the voluntary associations that it has been possible for such provisions as are included in the misleading term “sanatorium benefit” to pass into law without serious opposition.

Much has been accomplished. The question remains what has still to be done? Is it true that “consumption” can be prevented, and if so, how?

The mortality from tuberculosis in England and Wales has diminished, during the last 50 years, by more than 50 per cent. It may reasonably be assumed that the incidence of the disease has diminished in proportion. The cause of this decrease in the death rate has been considered from many

and various points of view. Those who speak with the highest authority are not unanimous in their opinion as to its true significance. Some attribute it to the better housing of the poor and improved sanitation; some to lessened intemperance and a better general standard of living; some to a fuller understanding of the methods by which the disease is spread; some to the segregation of incurable cases at the time when they are most likely to prove sources of contagion to those about them; and some to an increasing immunity to tuberculous infection, owing to the fact that so large a proportion of the community have at some time or other been infected, and have therefore been able to resist further infection, or, in other words, have become immune.

Probably all these causes, in their several degrees, have been operative. At the same time, however much divergence of opinion there may be as to the means by which the diminution in the death rate from tuberculosis has been brought about, there can be none as to the methods by which the disease is spread, and the tale of its victims increased. It is, therefore, of the utmost importance that the public should learn what these are, and how they may be dealt with. They will then appreciate the necessity for adopting those measures by which its spread may be checked, and methods of prevention will be welcomed with approval instead of opposition.

Prevention is better than cure. In no case is this more true than in tuberculosis. Efforts at prevention affect the whole community, and can, therefore, be applied generally to the whole mass of the population. Efforts at cure, however successful, affect only individuals. There is no possibility of applying curative measures so widely or so generally as preventive; neither in the present conditions of the problem is there any hope that all cases treated will be cured. There are many other reasons why the treatment of tuberculosis cannot be expected to have so potent an influence on the reduction of the mortality as prevention, but this is not the place to consider them. It may, however, incidentally be remarked that public attention has in a great measure been diverted from the true key to the problem of prevention by the unfortunate term "sanatorium benefit," since the actual treat-

ment of individuals in sanatoria or dispensaries is not the most important of those measures which must be co-ordinated, if a successful stand is to be made against the spread of the disease.

It is, therefore, to the prevention, rather than to the treatment, of tuberculosis that public attention should mainly be directed. At the same time, it must be borne in mind that the successful treatment of every case is in itself a step towards prevention, since it diminishes the liability of others to the contagion of the disease. The dispensary from which infected homes can be visited, and contacts traced—the hospital to which certain cases requiring special treatment or operation, can be removed—the sanatorium for the treatment of early and hopeful cases—and asylums for hopeless and incurable cases, are all links in the chain which must be welded firmly and well, if the prevention of tuberculosis is to be brought to a successful issue.

Hopes based on any one single method of dealing with the problem are foredoomed to disappointment. The campaign must commence in the homes of the people, and with the people themselves.

It is of great importance that the public should clearly understand the meaning of, and necessity for, "notification," not only from the point of view of the treatment of obviously infected cases, but also from that of lessening preventable infection of "contacts." Unless, however, their confidence and co-operation is secured, it is not improbable that there will be a good deal of reluctance on the part of those living with actual cases of consumption to consult a doctor, or permit of examination. It is, above all things, necessary that discretion and forbearance should be exercised, whether by dispensary doctors, or district nurses and visitors. If a number of enquiries, which may be considered vexatious, are made, as I have known to happen, without any proposal for treatment or amelioration of the home conditions, antagonism and discontent are likely to arise, and the very ends of notification and of the enquiries to be defeated.

It is useless to inform destitute families crowded together in unwholesome surroundings, when one of their number is suffering from consumption, that their conditions are such

as to make it probable that other members of the family will become infected, unless something is done to alter the conditions. It is useless to inject a case of "open" tuberculosis, living in unfavourable conditions, with tuberculin, and leave it to be a source of infection to others. It is even useless to remove such a patient to a sanatorium, if he is the wage-earner, unless something is done to prevent the rest of the family from starving. No measures which fail to take these and other difficulties into account can hope to be wholly successful.

Further, it is useless to educate the public in the means by which tuberculosis can be prevented, unless the community are prepared to face the expense of carrying out the measures which are acknowledged to be necessary.

The end in view will best be accomplished by bringing clearly before the public—

- (1) The causes of the disease, and how much the individual can do to protect both himself and the community from becoming victims to the contagion.
- (2) The methods by which the contagion gains access to the body, and the conditions which lead to its becoming inoperative and powerless for harm.

They need to be convinced that the actual causes of the disease are capable of being seen and handled, and that, apart from the tubercle bacillus, tuberculosis cannot originate *de novo*, or be spread.

The two most obvious sources from which tuberculosis may be derived are :—

- (1) The expectoration of persons suffering from consumption.
- (2) Milk from cows infected with tubercle.

Though there are other possible sources of the poison, they are either so rare or so purely accidental that it is doubtful whether human foresight, with our present knowledge, could take practical measures to combat them.

Much has been done to check the disgusting habit of promiscuous expectoration in our streets and public places,

since the London County Council had the courage, at the request of the N.A.P.C., to make it an indictable offence ; and the railway companies have given valuable assistance in the matter, so that now it may fairly be assumed that the great majority of the population appreciate, at any rate, the fact that the contagion of "consumption" is conveyed by the sputum from those who are affected to those who are susceptible, and in self-defence they desire to see the byelaw carried out, and are willing to give their assistance.

It is of the utmost importance that both communities and individuals alike should take to heart the lesson, that they must rely quite as much on what the individuals do for themselves as on that which is done for them.

The public need to be impressed with the fact, that the consumptives themselves can do more than anyone else to prevent the spread of consumption, by preventing the secretions, which contain the poison, from becoming a source of danger to those about them. Thus it should be impressed on those who are actually suffering from the disease, how necessary it is for them to exercise scrupulous care about coughing and spitting, and to use some kind of sputum flask, such as is now obtainable at most of the hospitals and dispensaries. In some local health areas they are supplied free of charge.

Next as regards the spread of the disease by milk. The fact that a Royal Commission has recently and emphatically declared that the milk of tuberculous cows, even when the udders were not affected, was found to contain tubercle bacilli, needs to be brought home to all who have the charge of children. There is only too good evidence to lead to the suspicion that a contaminated milk supply is responsible for much preventable tuberculous disease. There is reason for supposing that tubercle bacilli, ingested with milk in infancy, may remain dormant in affected glands for many years, and may in fact be responsible for some after-cases which occur during the years of life in which the disease is most fatal.

It rests with the community to determine whether they will submit to the existing state of things, or insist on such precautions being taken as may put an end to this danger. A Bill was actually introduced by Mr. Burns, which was

designed to grapple with these questions, but it was allowed to drop. The public should see that the matter is not in this way permanently shelved. This country is behind many American cities in this matter. In New York, Washington, and Rochester, N.Y., milk is sold as "inspected," *i.e.*, from dairies subject to official inspection, and "certified," *i.e.*, from cows which have passed the tuberculin test.

The public need to be taught that they have a right to be able to purchase pure milk, and that it is risky to use milk without any guarantee of its purity, unless it has first been "pasteurized." That the disease is always conveyed from one individual—human or bovine—to another, mainly by dried expectoration or by milk, and that it cannot arise spontaneously, are the most vital factors of the whole question under consideration. When those facts are once really taken to heart, it will not be long before the necessary preventives are applied.

Next, it is specially desirable that all should realize the methods by which the contagium gains access to the body; these are:—

- (1) Through the air passages.
- (2) Through the digestive tract.
- (3) Through the skin, though this occurs but rarely.
- (4) Still more rarely, and quite exceptionally, directly from parent to offspring before birth.

The significance of this latter fact needs to be realized fully, since it gives the assurance that it is by no means necessary for the children of tuberculous parents to be themselves tuberculous, if only proper precautions can be taken. Further, it needs to be impressed strongly upon the public mind, that, for any contagium to produce an effect, it is necessary that it should be in sufficient quantity, and of such virulence, as to be able to overcome the powers of resistance of the victim.

Another important fact, which needs to be understood, is that the effects of the contagium, after it has gained entrance to the body, is greatly increased when the powers of resistance of the individual have been weakened by other diseases, feeble health (whether hereditary or induced by vice), intemperance, bad sanitary environment, lack of proper food, or profound mental distress. Therefore, every effort should be made to

do all that is possible, not only to lessen the amount of the contagium and to weaken it, but at the same time to strengthen the powers of the individual.

The deadliest enemies of the disease are sunlight, fresh air, cleanliness, free ventilation of rooms, and all that conduces to health and well-being. Its most potent allies are vice, intemperance, disease, insanitation, overcrowding, want, misery, and inherited tendencies. Some of these are under the control of the people—some unfortunately are not; but they need to be taught to realize that, unless the soil is prepared for the seed, it may not, even if it gains entrance to the body, do much harm, and that by keeping their bodies healthy, as far as lies in their power, they are raising up the most effectual barrier against the contagium of tuberculosis.

When the public have fully grasped these essential factors of the problem, they will begin to understand what it is necessary to do to prevent the spread of the disease. All can help, even though it be merely by refraining from making unnecessary difficulties, and by availing themselves of such means as have been put into their power for arriving at the desired goal.

Lastly, it remains to be considered in what ways these facts can best be impressed upon the mass of the people, so as to induce them to act upon them. It is one thing for experts to have the knowledge; but quite another thing to secure that this knowledge shall be diffused amongst those who most need it. I, for one, place but little confidence in the distribution of tracts and leaflets, except those of the very simplest description. I am convinced that the best health missionary is an old patient, who, having been treated successfully in a sanatorium, has learned lessons which he is eager to pass on to others.

Next to this I would place demonstrations, lectures, exhibitions, and the personal contact of those who have special knowledge of their subject, with those who are most concerned. Such exhibitions have been held with gratifying results in many parts of London, and all over the United Kingdom.

To quote the words of a recent appeal for funds, made by the National Association for the Prevention of Consumption,

20, Hanover Square :—

“The plan of education which has proved most effective is by means of :—

“(1) Travelling exhibitions consisting of diagrams, models, and pictures, giving a complete illustration in simple fashion of the causes of tuberculosis, and the prevention and treatment of the disease.

“(2) Caravans of a similar nature. Popular lectures with lantern slides are given in connection with both.

“(3) The distribution of literature.

“The exhibitions are held in the larger centres of population, while the caravans tour the country districts. Everywhere the people are eager to learn. The opening exhibition in Whitechapel attracted in 17 days 70,000 of the people who most require to be armed for their own defence. It has since visited 50 boroughs, and everywhere a like anxiety to learn all about the enemy, and how to keep him at bay, has been shown. The total attendances have reached nearly *one million.*”

THE NATIONAL INSURANCE ACT.

That practical instruction in the subject can, in this way, be brought before so large a number of persons of all classes cannot fail to be a potent influence for good. Fortunately, there is more than one voluntary association able and willing to carry on this propaganda work, such as the National Association, which has been mentioned, the Women's National Health Association of Ireland, the Brompton Hospital, the Jewish Board of Guardians, and others. Every one of these bodies has been doing splendid pioneer work in endeavouring to show the people what can, and what ought to be done, and how to do it.

It is to be hoped that these efforts to bring the facts forcibly before the masses, from whom the bulk of the sufferers come, will meet with the generous support which it deserves, and that those who are responsible for carrying out the details of the “sanatorium benefit” will encourage these voluntary associations. By so doing they will assist, in a very practical way, in promoting the work which they

have undertaken.

Besides these voluntary associations, much can be, and has been, done by Medical Officers of Health, hospitals (especially by the out-patient departments with almoners), dispensaries, and district nurses. By means of all of these, the people can be reached, where it is most important that they should be reached, in their own homes. If such means are co-ordinated and utilized, there is no reason why the public should not be educated in everything which is essential to the carrying on of a successful campaign.

This is not the place to go into details, but it is necessary to utter a word of caution against raising extravagant ideals or hopes which can never be fulfilled. It is, above all things, essential that the public, when they have been taught what is needed, should not find, as, unfortunately, in the past has not infrequently been the case, that there are no funds and no machinery for carrying out the measures or the treatment, without which, as they have learned, there is no hope of prevention or of cure.

The measures proposed for dealing with the problem of tuberculosis are still under discussion, and are receiving keen criticism. It is impossible but that there should be some delay. Time is needed to elaborate details, and the fact that a complete and effective working scheme has not been produced to order in a few weeks, is no proof that the scheme itself is faulty in principle.

But it is essential that the Act shall be administered in a statesmanlike manner, and not in a parochial and niggardly spirit, if the hopes which have been formed of it are not to be disappointed.

Under the Act, "sanatorium benefits" *can* be extended to the dependants of insured persons, yet the Insurance Committee for the County of London, which has to deal with the tuberculous cases from a population of several millions, are not at present prepared to do even this.

It may well be asked what is the use of notification, dispensaries, domiciliary visits, searching out of contacts, etc., if nothing is to be done for any but insured persons. Unless *all* tuberculous cases are to be included in the scheme there is little chance of its ending in anything but disappointment and failure.

PUBLIC HEALTH AND TUBERCULOSIS :

WITH SPECIAL REFERENCE TO THE HOUSING PROBLEM.

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TUBERCULOSIS is a disease of man and animals under domestic conditions. Comparatively unknown and infrequent among nomadic and barbaric peoples who followed primitive conditions of life, it has in polymorphic form been the scourge of semi-civilized and civilized nations during many centuries. Like other diseases which have their inception in, or are aggravated by, insanitary environment, tuberculosis has been susceptible to the gradual improvement in sanitary conditions of our towns and cities, quite apart from any special provisions for its amelioration or prevention. This is well exemplified in the following short tables:—

TABLE I.

TABLE SHOWING MORTALITY PER MILLION PERSONS LIVING IN ENGLAND AND WALES AND SCOTLAND FROM TUBERCULOSIS (ALL FORMS) AND FROM PHTHISIS FROM 1871 TILL 1900.

		1861-70.	1871-80.	1881-90.	1891-1900.
England and Wales	Tuber- culosis (all forms).	3,239	2,862	2,429	2,010
Scotland	„	3,620	3,470	2,750	2,370
England and Wales	Phthisis	2,545	2,190	1,775	1,391
Scotland	„	2,560	2,390	2,000	1,690

TABLE II.

TABLE SHOWING DEATH RATES PER 1,000 OF POPULATION FROM PHTHISIS AND DISEASES OF RESPIRATION IN ENGLAND AND WALES DURING SOME DECADES.

		1851-60.	1871-80.	1881-90.	1891-95.
Phthisis	- - -	2.18	2.12	1.72	1.46
Respiratory diseases	-	3.02	3.00	3.18	3.74

If the total number of deaths from pulmonary phthisis in Scotland, in the year 1904, be distributed between the rural

districts and the urban centres, the following result is found :—

TABLE III.

					Number of Deaths.	Death Rate per 1,000.
Rural districts	-	-	-		1,735	1·108
Burghs	-	-	-	-	4,410	1·441

This shows what is well established, viz., that tuberculosis is mainly a disease of the populous centres.

As indicative of the fact that the death rate from phthisis is susceptible to the influences of improved sanitary conditions generally, it will be sufficient to say that in Scotland during the years 1855-1894 the death rate had fallen by fully one-half, and in England and Wales by about two-thirds, compared with previous death rates.

It has now come to be recognized that the potent factors in the development of tuberculosis are, not so much the condition of the soil or altitude of a place, as the intimate home life of a people and the conditions of their environment, employment, and consanguinity.

As our knowledge grew concerning the genesis and sources of infection of the disease, by the discovery of the bacillus of tuberculosis by Koch in 1882, by the belief that tuberculosed animals, such as the cow, could transmit the organism in its milk through a tuberculosed udder, and that under certain ill-defined conditions the tuberculosed flesh of animals eaten by man might prove inimical, the avenues of prevention have become more and more defined. Following the recommendations of the Royal Commission on Tuberculosis, 1898, came the Dairies, Cowsheds, and Milkshops Order of 1899. It will be remembered that in that Order the Local Government Board amended Article 15 of the Order of 1885, which read as follows:—"If at any time disease exists among cattle in a dairy or cowshed or other building or place, the milk of a diseased cow therein (1) shall not be mixed with other milk; (2) shall not be sold or used for human food; and (3) shall not be sold or used for food of swine or other animals unless and until it has been boiled."

In this Article the word "disease" only included the diseases named in the schedules under the Diseases of Animals

Acts. The amended Order of 1899, however, laid it down that the word "disease" should be held to include "such disease of the udder of a cow as is certified to be tuberculous by a veterinary surgeon." The main provisions of the other Orders of 1885 and 1887 had to do with the registration of dairies, the inspection of cattle in dairies, the prescribing of lighting, ventilation, cleansing, drainage, and water supply of dairies and cowsheds, the securing of cleanliness of milk stores, milk shops, and milk vessels used for containing milk for sale, and prescribing precautions to be taken for protecting milk against infection or contamination, and authorizing local authorities to make regulations for all or any of the above-named purposes. The recommendations of the Tuberculosis Commission of 1898 respecting cowsheds, to which the Local Government Board drew the attention of local authorities with the issue of the Order of 1899, if insisted upon by local authorities, would go a long way to secure sanitary and healthful conditions for cows.

There can be no doubt of the need for such recommendations. The systematic examination of milk sent into our towns and cities shows that, in not a few samples, tubercle bacilli are to be found, as proved by the effects of the inoculation of guinea-pigs with the centrifuged milks. The time has arrived for the legislature and the public to demand regular and thorough veterinary inspection of milch cows, and for the public, at least, to give every encouragement to dairy farmers to produce certificates of freedom from tuberculosis of their herds, as proved by the tuberculin test. From the abattoirs of every country of the world comes also evidence of tuberculosed carcasses. In the German States, for example, it has been found that of the animals slaughtered for human food, the percentage of tuberculosed animals varied from 3.57 in Baden up to 37.5 per cent. in Zwickau; in France from 9.25 per cent. in Toulouse to 25 per cent. in other districts; in Holland, 8.12 per cent. in Amsterdam, 7 per cent. in Rotterdam, and 4.17 in Leyden; and in Copenhagen, 26.87 per cent. of the animals killed in 1897. The percentage figures of animals found on slaughter to be tuberculosed in this country varies, but in Glasgow in 1910 it proved to be 4.57 in the case of oxen, 12.65 in bulls, 24.51 in cows, 9.69 in heifers, and 0.31 per cent. in calves. In respect of tuber-

culosed flesh, also, in order to prevent such being sold for human food, the Commission of 1898 issued a series of valuable recommendations regarding the disposal of carcasses found after slaughter to be affected with tuberculosis.

By the Public Health (Regulations as to Food) Act, 1907, Local Government Boards are empowered to make regulations authorizing the measures to be taken for the prevention of danger to the public health from the importation, preparation, storage, and distribution of articles of food and drink intended for sale for human consumption, and to take samples of any such articles. In addition, there are various provisions in the Public Health Acts regarding the seizure of unsound food and of food unfit for human consumption. The Commission of 1898, moreover, recommended "that the Local Government Board be empowered to issue instructions from time to time for the guidance of meat inspectors, prescribing the degree of tubercular disease which, in the opinion of the Board, should cause a carcass or part thereof to be seized." But, so far as we are aware, no such instructions have been issued.

It may be that the delay was due, in the first instance, to the startling statement of Koch in London, in 1901, regarding the non-identity of human and bovine tubercle, and later, to the appointment of the Royal Commission on Tuberculosis (Human and Bovine), 1901. But the laborious work of that Commission is now completed, and it has been shown that "beyond all doubt human tuberculosis cannot be distinguished from bovine tuberculosis;" and, further, "that there can be no doubt but that in a certain number of cases the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction into the human body of the bacillus of bovine tuberculosis; and there can also be no doubt that in the majority, at least, of these cases the bacillus is introduced through cow's milk. Cow's milk containing bovine tubercle bacilli is clearly a cause of tuberculosis, and of fatal tuberculosis in man. . . . Our results clearly point to the necessity of measures more stringent than those at present enforced being taken to prevent the sale or the consumption of such milk." The findings of the Commission point a clear way, therefore, for sanitary authorities. The real reason why the Local Government Boards have done nothing is, that they do not yet possess statutory powers

to make such regulations. Further legislation does not, therefore, seem to be necessary to prevent the spread of tuberculosis from milk, but it is desirable for standard methods of inspection of meat.

When Koch demonstrated that tuberculosis was due to a specific bacillus, enquiry came to be made regarding the sources of infection, since it had now to be looked upon as an infectious disease, having specific differences from other infectious diseases. The enquiry revealed that the causes of pulmonary infection probably arose in the following order of frequency :— (a) Inhalation of the bacillus from desiccated tuberculous expectoration ; (b) consanguinity by marriage ; (c) propinquity of persons living intimately in the relation of husband and wife, of sisters or of brothers, who occupy the same room and the same bed, and where one is affected by the disease ; and as indirect but auxiliary causes, (d) conditions of housing, of employment or occupation, and of atmospheric pollution.

As provocative of the disease were insanitary home environment, smoky town atmospheres, and dust-laden air in occupations. It cannot be supposed that conditions such as these, which give rise to high respiratory death rates, should eliminate or exclude phthisis as a possible consequence of the pulmonary irritation. Especially is this true in regard to foul domestic atmospheres and imperfect ventilation of rooms. This has been demonstrated by the graded increase in the death-rates from pulmonary tuberculosis, in proportion to the decrease in the house space unit per family. While it is true to say that, under certain circumstances, density of population on the land and per room are inimical to health, probably too much blame has been laid upon the houses themselves as the chief factor. Statistics of most large towns and cities show that the highest death rates obtain among those living in the smallest houses.

But while the houses themselves cannot be left out of the reckoning of causation, it must not be forgotten, when drawing inferences from such statistical results, that it is in the smallest houses that persons live whose struggle for existence is the hardest, as well as those who lead immoral, criminal, dissolute, and lazy lives. Density of the population upon the ground does not begin to operate as an inimical factor until long after privation, want, and the effects of

evil conduct have done much harm. Indeed, we are more and more convinced that these are the prime factors in the causation of the high death-rates. Density per room operates more rapidly, perhaps, than evil habits, because of the more intimate character of its effect upon the inmates, since overcrowding of a room at once fouls the air breathed in common by all the inmates, to maintain the purity of which in small rooms is impossible by the laws of ventilation. Among the very poor, the maintenance of bodily warmth in winter is the prime consideration, relative to which ventilation in their view, is but a secondary matter.

The following table for Glasgow illustrates what is commonly discovered in the statistics of large cities and large towns, regarding the occupants of small houses.

TABLE IV.
DEATH-RATES FOR GLASGOW IN 1901 IN POPULATIONS OF HOUSES OF
DIFFERENT SIZES.

Size of House.	Census Popula- tion.	Death Rate. All Causes per 1,000.	Zymotic Death Rate per 1,000.	Phthisis Death Rate per 1,000.	Respira- tory Rate per 1,000 including Croup).
One apartment -	104,128	32.7	7.4	2.4	7.6
Two apartments -	348,731	21.3	4.5	1.8	4.6
Three .. -	151,754	13.7	1.6	1.2	2.4
Four apartments and upwards.	136,511	11.2	1.0	.7	2.0
Institutions and Harbour.	20,588	—	—	—	—
Whole City - -	761,712	20.6	3.8	1.8	4.8

It will be observed that the death-rates from all causes, from phthisis, and from respiratory diseases, are much higher among the inhabitants of one-apartment houses than among those of houses of more apartments. There would seem to be an unaccountable disproportion between the death-rate from all causes in the one-apartment population and those of the other classes of houses. Up till the census of 1911 this was somewhat inexplicable, but owing to the age distribution of the populations of the different classes of houses being then worked out for the first time, some explanatory light has been

thrown on the subject. It appears from the Census Returns of 1911, that almost one-fifth (19 per cent.) of the one-apartment population in the city is composed of children under five years of age, whereas the corresponding ratio for all the classes of houses over the whole city is only a little over one-tenth (11 per cent.). The distribution of the population of Glasgow with reference to housing accommodation during 1911 was found to be as follows:—The number of inhabited one-room houses was 32,742, and the population of these houses was 104,641; of two-room houses, 75,536 with a population of 367,341; of three-room houses, 30,775 with a population of 160,983; of four-room houses, 10,817 with a population of 54,238; and of five-room houses and upwards, 13,194, with a population of 73,311 persons. The total number of inhabited houses of all kinds in the census year was, therefore, 163,064, with a population of 759,614, to which must be added for institutions and shipping 24,882, to make up the entire population of the city, viz.:—784,496 persons.

The problem of housing the poorer working classes seems not to be without considerable difficulty in solution. A "slum" is not constituted solely of broken-down houses, but also of broken-down occupants, and it is, perhaps, easier to remedy the one than the other. Indeed, it would appear as if the housing problem will remain for the consideration of recurring generations because of the variable factor of the occupant. But so long as slum districts continue to be the nursery-grounds for epidemic diseases, such houses and populations are a real menace to the health and well-being of the citizens generally. Cities are the product of a long evolution in housing. In their growth, during centuries perhaps, the housing mistakes of former generations, due to absence of, or to defective or insufficient building regulations, are apt to survive long after they have served their day; hence, cities must get rid of these relics of ancient days, before they can pretend to exhibit the beneficial effects which years of enforced sanitary enactments and provisions ought to show. The power to remove such encumbrances of light and air, and to provide houses under improved conditions for the working classes and the poorest classes, has for a long time been placed in the hands of local authorities under different general and local statutes. It is not necessary to consider

these in much detail. It is, perhaps, sufficient to say that in the Housing of the Working Classes Acts, 1890 to 1909, the Housing, Town Planning, etc. Act, 1909, and in certain sections of the Public Health Acts, abundant provision has been made for these purposes. The full title of the Housing of the Working Classes Act, 1890, ought to be kept in mind, viz.:—"An Act to consolidate and amend the Acts relating to Artizans' and Labourers' Dwellings and the Housing of the Working Classes." Part I. of that Act deals with unhealthy areas, and the procedure for schemes for their improvement; Part II. with unhealthy dwelling-houses, and the procedure for closure and demolition of these, together with the removal of "obstructive" buildings; and Part III. with Working Class Lodging Houses, which shall include separate houses or cottages for the working classes, whether containing one or several tenements, the expression "cottage" to include a garden of not more than half an acre, provided that its estimated annual value does not exceed three pounds.

The Housing, Town Planning, etc. Act, 1909, is the last word which has been said by Parliament on the subject of housing. Attention is drawn to the following sections. Section 17 declares it to be the duty of the local authority to cause their district to be inspected from time to time, with a view to ascertain whether houses dangerous or injurious to health as to be unfit for human habitation therein exist, and to cause records of such inspections to be made and preserved; determines the procedure whereby a closing order to shut a house may be made; and declares the conditions under which a dwelling partly underground may not be inhabited. Section 18 enacts, that when a closing order has been in operation for three months, and no steps have been taken by the owner towards the necessary remedy, the local authority shall consider the question of demolition of the house and shall proceed in terms of the statute. These two sections supersede sections 32 and 33 of the Housing Act of 1890, and the owner of a house, dealt with under these sections, has the right of appeal both against a closing order and a demolition order, and *no compensation* is payable to such an owner either in respect of closure or demolition. Section 10 of the Town Planning Act, 1909, confers on the Local Government Boards, on complaint against a local authority that they have failed

to exercise their powers under Part II. or Part III. of the Housing Act, 1890, power to enforce the exercise of such powers, and in section 11, where a local authority has failed to carry out an improvement scheme under Part I. of the Act, or to give effect to an order as respects an obstructive building, or to a reconstruction scheme under Part II., or have failed to cause to be made an inspection of their district as required by the Act, to make an order that the scheme, or thing complained of, shall be carried out within a time fixed by the order.

Section 15 is an important section. It lays down the conditions as to keeping in repair houses let to persons of the working classes. Where a landlord of a house has failed to keep a house reasonably fit for human habitation, the local authority may, by notice, require the landlord to execute such works as shall be specified therein as necessary to render the house in all respects reasonably fit for human habitation.

In addition to the power given to the Local Government Board to "jog the elbow" of a slow local authority, the Board by section 37 may initiate action. Power is given in that section to the Board, if it appears to them that, owing to density of population or any other reason, it is expedient to inquire into the circumstances of any area, with a view to determining whether any powers under the Housing Acts should be put in force in that area or not, to require the local authority to make a report to the Board regarding the area, respecting any matters about which the Board desire information. The only other provision of the Town Planning Act to which attention need be drawn, apart from the Town Planning sections, is that, whereas under the Housing Act of 1890, section 8 (6), any provisional order made by the Local Government Board, after an inquiry with regard to an improvement scheme, did not become operative unless, and until, it had become confirmed by Act of Parliament, the amendment in the Town Planning Act does away with the need for Parliamentary confirmation.

The unanimous opinion of sanitarians is condemnatory of back-to-back houses as places of human habitation, and section 43 of the Town Planning Act most properly makes it unlawful to erect any such houses after the passing of the Act, any such house so erected to be deemed to be

unfit for human habitation for the purposes of the Housing Acts. This prohibition strikes at back-to-back houses which are distinct and separate buildings, each placed back to back of the other; but the prohibition is not extended to the erection or use of a house containing several tenements, in which the tenements are placed back to back of each other, provided the medical officer of health for the district certifies that the several tenements are so constructed and arranged as to secure *effective* ventilation of all habitable rooms in every tenement. It is very difficult, indeed, to comprehend by what form of planning of such houses *effective* ventilation may be secured. True, some measure of ventilation is possible, but to that measure the word *effective* is not applicable.

Of the Town Planning sections of the Act nothing need now be said, as the provisions therein contained are well known. It may be concluded, therefore, that so far as housing is concerned there does not seem to be any obstacle in the way of improving housing conditions, especially against recalcitrant owners.

But with relation to tuberculosis the subject of housing has other aspects. There arises the question of the fitness of certain classes of houses for the domiciliary treatment of cases of pulmonary tuberculosis. It is obvious that it can only be after a searching inquiry into the housing circumstances of persons notified to be suffering from that disease, that local authorities will be able to arrive at sound conclusions as to treatment, domiciliary or institutional. Pulmonary phthisis is now declared to be an infectious disease within the meaning of the Public Health Acts; consequently, the question must be faced whether a given person has "proper lodging or accommodation or is so lodged that proper precautions cannot be taken for preventing the spread of the disease."

There can be no doubt that effective isolation is practically impossible in one-room houses, when occupied by another person or other persons besides the patient, and probably in most instances in towns and cities, equally practically impossible in two-room houses. It is quite true that the patient may sleep at night by himself in one of the two apartments, but in all probability he will spend most of his waking hours in the company of other occupants in the other living apartment. In the Reports to the Local Govern-

ment Board for Scotland on the Administrative Control of Pulmonary Phthisis in Glasgow, based upon actual visitation of cases by the medical officers of the Board, the foregoing conclusions are supported. The possibility of domiciliary treatment of patients in these classes of houses will depend upon the interpretation by each local authority of the expression "effective isolation," but, while impossible in one-room and two-room houses, effective isolation is reasonably possible in houses of three or more rooms, hence the problem of removal to a sanatorium in the latter cases does not arise.

The chief difficulty experienced by patients, who have for longer or shorter periods undergone open-air treatment in a sanatorium, is to settle down into their ordinary home surroundings and circumstances. They take badly to the confinement of the workshop or factory, and of the home of limited-sized apartments. Those who have observed the after-state of patients on return from sanatoria, know the disastrous results which frequently follow a return to the old conditions. In this, pulmonary phthisis differs from other infectious diseases. A patient contracts small-pox in poor quarters, is removed to hospital, is therein treated, and is discharged well, whereupon he returns to his usual haunts, not only with no chance of again contracting the disease, but actually armed or protected against another attack because of his illness. But the consumptive patient who, entering a sanatorium and benefiting by the treatment, leaves for his home, is not cured, but is liable after return to a recrudescence of symptoms, or, if apparently cured, is liable to another attack of the same disease. Indeed, the problem of the future respecting the sanatorium patient will be not so much the possibility of treating him in a sanatorium, but how to treat him after he is fitted to leave the sanatorium.

It is likely, indeed, that such measures as have been already adumbrated, in addition to increased numbers of open spaces in our cities, closer attention to ventilation of occupied rooms and workshops, greater insistence on smoke-consumption, street-cleansing, and scavenging generally, rigorous periodic examination of milch cows, and systematic meat inspection will produce a lowered mortality from tubercular diseases; but so long as overcrowded, imperfectly lighted, badly-ventilated houses exist, these diseases will more or less prevail.

PUBLIC HEALTH AND TUBERCULOSIS.

(WITH SPECIAL REFERENCE TO THE "SANATORIUM BENEFIT" UNDER THE NATIONAL INSURANCE ACT).

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GENERAL CONSIDERATIONS.

THE loss in life from pulmonary tuberculosis is enormous—one quarter of the total deaths (males) between the ages of 25 and 55 years, and 1 in every 3 of the poor-law deaths, together with a loss in illness (and, in consequence, in efficiency) in similar proportions; whilst the corresponding loss in money to the nation is about 10 to 15 millions of pounds sterling—14 per cent. of the total poor-law expenses. Nine per cent. of the total pauperism of the nation is due to the disease.

The compulsory notification of the disease was, from time to time, suggested to Government, but the suggestions were in vain, despite the well-known fact that the compulsory notification of a disease is the first important step in prevention. Fortunately, the year 1911 will stand out as a landmark in sanitary administration by the Local Government Board, being the year when the system of compulsory notification of pulmonary tuberculosis, the chief form of the disease tuberculosis, by regulations was completed. Hospital (or dispensary) cases and private cases complete the system with the poor-law cases, which became compulsorily notifiable in 1908. The three sets of Regulations are known as:—(1) Public Health (Tuberculosis), 1908; (2) Public Health (Tuberculosis in Hospitals), 1911; and (3) Public Health (Tuberculosis), 1911.

The difficulty in securing compulsory notification of the disease, was, owing to its nature, its apparent non-infectiousness, and the anticipated difficulties of dealing with the disease in the way of isolation of patients, disinfection, etc. The liberty of the subject would, it was thought, be interfered with seriously. It cannot be emphasized too often

that pulmonary tuberculosis is, only to a limited extent, an infectious disease, and that its spread to others can be prevented by simple measures, whilst the disease itself can often be arrested, or even cured, if its nature be recognized early, and if proper means be taken for its prevention. The careful consumptive is not a source of danger to others.

Education of the people is needed, and this will be helped materially by the disease having been made compulsorily notifiable and brought, thereby, under systematic official survey and control. At the same time, powers of compulsory removal to hospital of patients suffering from pulmonary tuberculosis may not be necessary, in the sense that they are for the other infectious diseases, such as small-pox, scarlet fever, diphtheria, etc.; and, in this connection, it is worthy of note that, as a matter of fact, St. Helen's is the only sanitary authority in this country, at present, possessing such powers. Detection, treatment, and prevention of the disease are the three important measures needed.

The history of the passing of the Public Health (Tuberculosis) Regulations through Parliament is interesting. Section 130 of the Public Health Act, 1875, as amended by succeeding Acts, gives power to the Local Government Board, from time to time, to make, alter, and revoke regulations with a view to the treatment of persons affected with any infectious disease and for the prevention of its spread. The Board's advisers expressed the belief that pulmonary tuberculosis, being, in the opinion of experts, an infectious disease, came under such section, and the experiment was, consequently, tried by the making by Order of Regulations, called the Public Health (Tuberculosis) Regulations, 1908, which came into force on January 1, 1909, dealing with the compulsory notification of pulmonary tuberculosis in connection with all poor-law patients (institutional and district).

As was to be expected, these Regulations covered a wide area—roughly, half of the cases of pulmonary tuberculosis existing—and the experiment was so successful that the Board, backed by expert and lay opinion, had no alternative but to extend their scope. This was done by issuing, again under Order, new Regulations, known as the Public Health (Tuberculosis in "Hospitals") Regulations,

1911, dealing with the disease, *i.e.*, its compulsory notification, in connection with all in-patients and out-patients of "hospitals"—the term "hospital" being defined widely so as to include not only hospitals properly so called, but also dispensaries and other institutions (other than those of the Poor Law). This second set of Regulations came into force on May 1, 1911, and was at once followed by a third set of Regulations, known as the Public Health (Tuberculosis) Regulations, 1911, which came into force on January 1, 1912, dealing with private patients suffering from the disease, making such compulsorily notifiable.

In this way, *all* known cases are roped in by the administrative cordon. What now remains is to simplify and codify all the three sets of Regulations by the issuing of a new set, whilst provision might, with advantage, be made for the notification of doubtful or suspicious cases of the disease—the so-called "contacts," "suspects," or "infects," as everything depends upon the knowledge of the disease in its very early stages, when the prospects of its arrest, or cure, are at their best.

In connection with the compulsory notification of pulmonary tuberculosis, it may be mentioned that the Local Government Board has ruled that section 75 of the Public Health (London) Act, 1891, and the same ruling would naturally apply to section 131 of the Public Health Act, 1875, gives power to sanitary authorities to provide, out of the rates, sanatoria and tuberculosis dispensaries (including also tuberculin dispensaries). The importance of these decisions and actions of the Local Government Board cannot be exaggerated.

What is the nature of the havoc wrought by the disease? Taking the figures of the Registrar-General, published for a British Congress on Tuberculosis, the mortality in England and Wales at all ages from the disease, for the periods under review, was equal to a rate of 1,521 (males) and 1,141 (females) per million living. Under 5 years old, the rates were (males) 403 and (females) 334 per million; whilst the rates for children between 5 and 10 years and 10 and 15 years old were 140 and 195 (males) and 201 and 410 (females) per million, respectively. In both sexes, the real liability to the disease begins somewhere between the 15th and 20th year, attaining its

maximum at ages 45-55 (males), when it reaches 3,173 and at ages 35-45 (females), when it reaches 2,096. In both sexes, the rate rapidly declines after the attainment of its *maximum*. In other words, the incidence of the disease is upon the ages from 15 to 75 years, very old people and young children being, comparatively, exempt.

In passing, it is worthy of note that, taking the statistics for many years back, there has been an apparently gradual *decrease* in the mortality ascribed to the disease at every age-group in both sexes—the rate of decrease varying widely and being much greater amongst females than amongst males. This decrease may be due, in part at least, to improved diagnosis and certification, but general sanitary administration must, undoubtedly, take credit for the largest share. Lastly, the incidence of *maximal* mortality from the disease has been delayed, or postponed, in later years in both sexes. Such is the nature of the havoc wrought by the disease in deaths, and there is, of course, a corresponding amount of illness prior to death. Workers are severely hit by the disease, and some trades more than others—the well-known occupational consumption. Prolonged infection at certain trades increases the mortality—and *pari passu* the morbidity—rates from the disease as shown by the following table:—

COMPARATIVE MORTALITY FIGURES OF MEN AGED 25 TO 65 YEARS PER MILLION LIVING, TAKING THE RATE FROM ALL CAUSES AS 1,000.

Occupations.	All Causes.	Pulmonary Tuberculosis.	Respiratory Diseases.
All males - - - -	1,000	192	224
Unoccupied males - -	2,215	448	294
Tin miners - - - -	1,409	508	377
Inn and hotel servants - -	1,725	476	313
Printers - - - -	1,071	411	106
Costermongers - - -	1,652	443	403
File makers - - - -	1,667	431	350
Cutlers and scissors makers -	1,309	371	389
Earthenware manufacturers -	1,706	333	668
Farmers - - - -	503	79	90
Coal miners - - - -	727	69	159

Tin miners, inn and hotel servants, costermongers, file makers, cutlers and scissor makers, printers and earthenware manufacturers suffer most ; that is, trades in which the nature of the work renders the lung tissue specially prone to invasion (often prolonged) by the specific germ. Much misery and suffering occur, the efficiency and earning capacities are limited and poverty and destitution result. Untreated and unrecognized early cases cause ill-health, and a consequent lowering of the capacity for work, followed by irregular employment and encroaching poverty, resulting in poor and less nourishing food and greater susceptibility to the disease. In this way, the vicious circle is maintained. The statistics of pauperism and pulmonary tuberculosis rise and fall together, showing an intimate relationship. The havoc caused by other forms of tuberculosis (other than the pulmonary) must be remembered when the National Insurance Act is dealt with, the "sanatorium benefit" having reference to tuberculosis in its widest sense.

FINAL REPORT OF THE ROYAL COMMISSION ON TUBERCULOSIS.

It is advisable to note, at this juncture, that the Royal Commission have come to the following conclusions with respect to the infectiousness of tuberculosis :—

- (a) That, in many cases, human tuberculosis is identical with the bovine disease, and that mammals and men can be infected reciprocally, the disease being communicable to man from infected (1) cows' milk (milk, butter and cheese), or (2) butchers' meat (pork or beef), whereas the danger from infected poultry or birds is negligible ;
- (b) That it follows, as a corollary, that the supervision (with regulations) of milk production and meat preparation is urgently needed ; and that the temporary relaxing of such supervision, which undoubtedly took place as the outcome of the late Prof. Koch's enunciation that the bovine and human forms were separate and distinct diseases and not intercommunicable, must cease forthwith, in view of the results of the careful scientific experiments carried out for the Royal Commission ;
- (c) That infants and children are the members of the

population especially endangered from the relaxation of such supervision ;

- (d) That the bacillus of lupus is of the bovine order, but of a modified type, and differs, in certain respects, from the usual "bovine" bacillus found in cattle.

General sanitary administration has done much, in the past, to reduce the tuberculosis mortality and morbidity rates, roughly speaking a 50 per cent. reduction, and this fact must not be forgotten. In addition to general sanitary administration, more detailed precautionary measures are now needed, and the National Insurance and Finance Acts 1911 come to the rescue.

THE NATIONAL INSURANCE ACT, 1911, ("SANATORIUM" AND OTHER BENEFITS) AND THE FINANCE ACT, 1911.

The National Insurance Act, 1911, is worthy of the Age—the Democratic Age—in which it was passed, and the value of its underlying principles no one can gainsay. Many amendments will be necessary before it is a workable Act, and the opposition of the medical profession to the sections more especially applying to them may be well grounded and will, doubtlessly, lead to a satisfactory compromise and the early amendment of the Act in that and many other directions. Despite such future amendments, the Act is epoch-making, in so far as the "benefits" under the Act are concerned, more especially in connection with tuberculosis—the so-called "sanatorium" benefit, and indirectly the "medical," "sickness," and "disablement" benefits. The effects of these benefits must be far-reaching, but must naturally depend upon the way in which they are administered. Common sense must be brought to bear, and overlapping and needless expense avoided.

The contributory nature of the scheme is clearly tentative only, as are also the limitations as to "approved" societies, "deposit" contributors, and "incomes." In the future, the basis of the Act must be broadened, the scheme made non-contributory, and the "limits" abolished. It is unreasonable that "benefits" (sanatorium and others), which are a new departure in British legislation and are excellent in design, should be restricted, as at present, to persons over 16 and under 70 years of age, whose incomes, except in the case of manual labourers, are less than £3 per week, and that, too,

only if such persons are in normal health at the time of joining an "approved" society and in normal employment! No provision is at present made for those who are ill and chronically unemployed, the casuals, the odd-jobbers, and the mentally-deficient, nor even for non-wage-earning women. The helpless are left out of the scheme! This article deals chiefly with the "sanatorium" benefit and incidentally with the "medical" benefit of the Act, in so far as this latter benefit will help to find out *early* cases of tuberculosis.

Attention must again be drawn to the fact that the National Insurance Act in its "sanatorium" benefit applies to tuberculosis in its widest sense and not to the pulmonary form of the disease (or consumption) only. Further, the "sanatorium" benefit is restricted under the Act at present to the "insured," but should be extended to *all*, whether "insured" or not. Indeed, it has practically been decided already to extend the "sanatorium" benefit to the families or dependants of "insured" persons, *i.e.*, to the wives and children, though, as a matter of fact, no monetary provision has yet been made in the Finance Act for such a purpose!

It may be mentioned here, in passing, that local authorities will become responsible for any deficit occurring in regard to "medical" benefit, administered under the Insurance Act, if they approve of the Budget submitted by the Insurance Commissioners, and if that Budget be approved by the Treasury. Any disapproval of such a Budget by the local authority or by the Treasury must be reasonable, of course. The "benefits" are to be dispensed by the Local Insurance Committees for "approved" and "deposit" contributors, but the Local Insurance Committees have other important duties allotted to them under the Act, *e.g.*, furnishing reports on the health of "insured" persons and taking proceedings against those responsible for excessive sickness rates due to bad housing, bad water supply, bad factory and workshop conditions; arranging for lectures on health; etc. Such duties as these are of a preventive nature, calling for the harmonious and concerted action of all voluntary and official forces so as to lead eventually to the ideal—a unified Preventive Medical Service.

Under the "sanatorium" benefit, sanatoria (taking the term in its widest interpretation) will be provided (*a*) for

the cure of early cases and (*b*) for the segregation (with treatment) of other cases of tuberculosis, whilst medicines and other treatment will be forthcoming for home cases—the so-called domiciliary treatment, together, of course, with the payments to be made during sickness and disablement, which may represent, in each case, a protracted period of two to three years before death. It is hoped, and expected, that the sickness and disablement payments will enable the insured members to avail themselves of proper treatment at an early stage of the disease (including early “sanatorium” treatment) and their families or dependants to be provided with food, etc., during the absence of the bread-winners in sanatorium or hospital.

INTERIM REPORT OF THE DEPARTMENTAL (TUBERCULOSIS) COMMITTEE.

The word “sanatorium” includes (1) tuberculosis dispensary, (2) sanatorium proper (for the open-air treatment of early cases), and other institutions such as (*a*) hospitals for acute cases, (*b*) homes for chronic or incurable cases and (*c*) convalescent homes, “after-care” working colonies, open-air schools, etc. The tuberculosis dispensary is the pivot upon which the scheme of detection, prevention and treatment must revolve. It is the receiving-house and clearing-house for *all* cases of tuberculosis within a district, acting as a centre of observation and diagnosis and, in connection therewith, the patients will be able to obtain curative treatment at the dispensary or from the dispensary at their homes, together with such institutional treatment elsewhere as may be required. The dispensary is the first unit in administration, working in close unison with the second unit—the sanatorium or other institution.

The dispensary will also act as an information bureau and a general educational centre for tuberculosis. The dispensary, therefore, should be under the administration and control of a whole-time officer, to be called the chief tuberculosis officer, well qualified in the diagnosis and treatment of tuberculosis, together with administrative experience. Such officer must be appointed by the sanitary authority and should work in unison with the Health Department, if not actually attached officially thereto. The salary offered

should be such as to attract and secure the services of a good man, *e.g.*, commencing at 500*l.* per annum. It is clear that, in large districts, assistant tuberculosis officers, in addition, will require to be appointed at salaries commencing at 300*l.* per annum (whole-time appointments), or, as an alternative, arrangements may be made for general practitioners practising within the district to act *in rota* (part-time appointments), to be paid by fees; if such a scheme be practicable, it may be added.

Patients will require to be visited at their homes and treated there, unless or until removed to sanatoria or other institutions, and home conditions must be noted and dealt with, whilst a careful search must be made for so-called "contacts," "suspects," or "infects." Much will depend upon finding out these early or commencing cases, patients in the very early stages of the disease, as already pointed out. Nurses, clerks, and dispensers will also be necessary. It may be noted, in passing, that tuberculosis officers, if unattached to Public Health Departments of sanitary authorities, will have no right of entry into the homes of the people, and no power to deal with insanitary defects that may be found, *e.g.*, dampness, want of ventilation and insufficient lighting. The capital grant for the establishment of a dispensary is, in the opinion of the Departmental Committee, to be up to four-fifths of the amount required (not exceeding, as an average, 240*l.* for each dispensary) and for a sanatorium up to three-fourths of the cost for each bed (not exceeding, as an average, 90*l.*). United and correlated action amongst all bodies and persons concerned is desirable, with the use of existing machinery and available funds as far as possible.

Another important point emphasized by the Departmental Committee is the necessity for enlisting the hearty co-operation, and stimulating the interest, of the general medical practitioners of the country. Their intimate personal relations with patients and their influence in the homes of the people are forces, which should actively be enlisted in the campaign against the disease, as aids to securing its early recognition and methodical treatment, as well as in promoting the effective after-care of cases, and in encouraging those healthy habits of life, which are so essential for building up the powers of resistance to the disease. Without the

sympathy and support of the general practitioner, any scheme must fail.

In conclusion, the Departmental Committee emphasizes the necessity for action being taken systematically in the case of children, childhood affording an excellent opportunity for detecting and dealing with tuberculosis. The more the resistant power of children is increased the better, and the factors, which tend to weaken the defensive powers of children, can be brought under control easily and at an early age. Malnutrition is specially deleterious in its effects and, of course, infection must be limited as much as possible, protracted infection being specially dangerous to children as to workers. Full details are given in the Report as to powers of existing authorities, work done by voluntary societies, and administration suggested for England, Wales, Ireland, and Scotland.

TUBERCULIN TREATMENT AND TUBERCULIN DISPENSARIES.

The establishment, in 1910, at 263, Kennington Road, London, S.E., and at Street (Somerset) of voluntary tuberculin dispensaries by the Tuberculin Dispensaries League, under the presidency of the Countess of Mayo, and the expert guidance of Dr. Camac Wilkinson, as chairman of the executive committee, and the establishment, in 1911, in Portsmouth of a municipal tuberculin dispensary under the control of the Portsmouth Corporation, have focussed attention upon one special aspect of the tuberculosis question. The schemes are young, and caution is needed before making *ex-cathedra* statements. Statistics are fast accumulating, however, in favour of the tuberculin treatment, and the results deserve, and certainly call for, investigation. The fiasco attending the Koch inoculation treatment, in recent times (1890), must not be forgotten during the return wave of optimism in regard to this particular form of treatment.

Drs. Rivière and Morland have recently written a book on *Tuberculin Treatment* (Oxford University Press, 1912), presenting a critical review of the whole subject, as have also Dr. Sahii (*Tuberculin Treatment*), and Drs. Bandelier and Roepke (*Tuberculin in Diagnosis and Treatment*). These may, with advantage, be read with the new edition of Dr. C.

Wilkinson's Weber-Parkes Essay* Reprint (Messrs. Nisbet & Co., Ltd., 1912) on *Tuberculin in the Diagnosis and Treatment of Tuberculosis*, which has recently appeared, and which is naturally, perhaps, prejudiced somewhat in favour of the tuberculin treatment as against *all* other methods. The truth, as usual, will be found in the middle course, *in medio tutissimus ibis*; viz., tuberculin injections are of value as one of the many means at hand for combating the disease, to be used with dispensaries, sanatoria, convalescent homes, open-air schools, etc., not forgetting again general sanitary measures. The right tuberculin, however, must be used. Koch used a sterilized glycerin extract of the tubercle bacillus, containing both exo-toxins and endo toxins, but success did not attend his efforts; and it has been left to Sir A. E. Wright to investigate the whole subject of immunization by bacterial products, and to suggest the new tuberculins.

The tuberculins of to-day may be divided into (a) old and (b) new, and may be grouped as follow:—

A.—OLD TUBERCULINS.

1. Tuberculinum Kochi O.T. ("old" human tuberculin).
2. Perlsucht Tuberculin P.T. ("old" bovine tuberculin).

B.—NEW TUBERCULINS.

3. Tuberculin Rückstand T.R. ("new" human tuberculin).
4. Perlsucht Tuberculin-Rückstand P.T.R. ("new" bovine tuberculin).
5. Tuberculin B.E. (human tubercle bacilli emulsion), together with the polygenous variety, made from eight different human tubercle bacilli cultures.
6. Perlsucht Tuberculin P.B.E. (bovine tubercle bacilli emulsion).
7. Tuberculin-original-alt T.O.A. (human).
8. Perlsucht Tuberculin original P.T.O. (bovine).
9. Human vacuum tuberculin, the same as 7, evaporated to one-tenth of its bulk at a low temperature and in partial vacuum.
10. Bovine vacuum tuberculin, the same as 8, evaporated to one-tenth of its bulk at a low temperature and in partial

* THE PRACTITIONER, February, 1910.

vacuum.

11. Koch's tuberculin A.F. (albumose free tuberculin).
12. Tuberculin S.B.E. (emulsion of sensitized tubercle bacilli or tuberculosis-sero-vaccine).
13. Béraneck's tuberculin T.Bk. and
14. Denys' tuberculin B.F. (bouillon filtré).

The first 8 are those in general use to-day—1, 3, 5, and 7 made from human, and 2, 4, 6, and 8 from bovine tubercle bacilli. Practical experience alone can settle which preparation is to be preferred, and, doubtless, the time will come for tuberculins to be prepared from the patients themselves for their own individual uses, as is done in streptococcic and pneumococcic infections.

The latest pronouncement on the subject (June 1912) is to use a sequence of (a) P.T.O., P.T., and O.T., or (b) B.E. and O.T. In the case of the first sequence, the initial dose of P.T.O. should be (average) 0.0002 c.c., at two to three days' interval until 0.5 c.c. is reached; then P.T. should be commenced with a dose of 0.01 c.c., increased until 1 c.c. P.T. is reached, when O.T. may be used, commencing at 0.1 c.c. O.T., and gradually increasing to 1 c.c. O.T., until there is no reaction. In the case of the second sequence, the initial dose of B.E. should be (average) 0.0001 c.c., increasing to 1 c.c.; followed by 0.1 c.c. O.T., increasing to 1 c.c., until there is no reaction on three separate and consecutive occasions at intervals of 8 to 12 days each. T.R. is stated to be useful when there is a tendency to get a high temperature, and B.E. in reducing the number of bacilli in the sputum; but in all cases, tuberculins are only to be used under certain conditions: for example, (a) absence of auto-inoculations, as shown by the absence of fever, (b) a fair condition of health, (c) freedom from other diseases, etc. A double or "mixed" infection is a definite contra-indication.

Koch's method of hypodermic injections, between the cutis and fascia, is the best way of administering the tuberculin; the injection should be made with a clean platinum-iridium needle into the back of the extensor surface of the arm or forearm, into the loin below the last rib, into the back between the shoulders (the interscapular region), or into the abdominal wall a little to the inside of the anterior iliac spine.

The skin of the part selected must first be cleansed and washed afterwards with alcohol. The tuberculin dilution should be recently prepared, and not used after 14 days from the date of its preparation, even though kept in a cool place meanwhile. Generally speaking, doses increasing at short intervals up to large doses, pushed cautiously to the extent of tolerance, the so-called "intensive method," give the best results.

Tuberculin has its limitations in treatment, but it is certainly capable of "arresting" the disease in certain cases, by immunizing the patients through the production of anti-bodies, and this "arrest" may be permanent or complete in the very early stages of the disease. The tuberculin must supplement other methods, and sanatorium and tuberculin treatments must be inter-dependent.

The value of tuberculin as a *diagnostic* must be remembered in the campaign against tuberculosis. For such a purpose, to obtain the specific reaction, the "old" tuberculin of Koch is employed in the four following ways or methods:—(1) Koch's hypodermic injections of graduated doses, commencing with 0.001 c.c.; (2) Von Pirquet's solution to the scarified skin like vaccination; (3) Calmette's solution to the conjunctiva; (4) Moro's ointment to the unbroken skin of the chest or abdomen.

AUTO-INOCULATION IN PULMONARY TUBERCULOSIS.

The method of auto-inoculations, practised systematically by Dr. Marcus Paterson, at the Brompton Hospital Sanatorium at Frimley, are fully set out in his book on *Auto-inoculation in Pulmonary Tuberculosis* (Messrs. Nisbet & Co., Ltd., 1911). Physical exercise induces auto-inoculations, that is to say, the introduction of bacterial products into the blood; systematic graduations of exercise regulate and control the extent of such auto-inoculations, the important matter being an accurate adjustment of physical activities to individual needs. The book is interesting and well worth the attention of all engaged in official work.

CONCLUDING REMARKS.

Tuberculosis is a disease of vast extent and calls for eradication, which will be helped considerably by the National Insurance Act and its "sanatorium" benefit. A broad view

is necessary, and all available means at disposal must be utilized. Everything must play its part—compulsory notification, anti-tuberculosis (including tuberculin) dispensaries, sanatoria and other institutions, domiciliary treatment (both prevention and cure), insurance and friendly societies, and (last but not least) general public health administration. The Insurance Commissioners, and their officials under the National Insurance Act, must work hand in glove with the Local Government Board and the Public Health authorities, and their officials, so as to prevent overlapping of administration, whilst all voluntary help must be welcomed, and voluntary and unofficial organizations and societies welded together into one gigantic Whole, if success is to crown efforts and render tuberculosis a disease of the past.

Improved social and sanitary conditions of the people are of great value both in their homes and in their workplaces, as are also wholesome, cheap, and abundant food and proper clothing. Improved housing, undoubtedly, increases the resistance to tuberculosis, and implies lessened opportunities for infection, as does also improved nutriment. The greater the number of bacilli introduced into the system, the greater the likelihood of the disease "catching on," for example, advanced cases being treated in poor and crowded rooms. Such advanced cases must be removed to institutions for treatment. Differences in susceptibility to the disease must be noted and allowed for. The early treatment of the disease is important in "sanatoria," and, for this purpose, there must be a careful search for "contacts," "suspects," or "infects" (as they are variously called) at the infected houses, thereby ensuring the treatment of the disease in the earliest stages, with subsequent arrest or cure. Coupled with this, there must be segregation away from their homes of the advanced cases of the disease, together with suitable treatment of the intermediate cases at the patient's homes (domiciliary treatment) or at institutions, such as hospitals for acute or chronic cases, convalescent homes, etc. (institutional treatment).

A sanatorium proper is not only useful for the treatment of early cases, by means of rest, exercise, food, and vaccines, but also for the education of the patients in simple preventive measures, and the actual prevention of the disease

by the removal from crowded localities, with their predisposing conditions, of the patients themselves. Public Health Authorities will require to be supplemented by the establishment and equipment of the two units mentioned in the report of the Departmental (Tuberculosis) Committee, viz., (1) dispensary and (2) sanatorium or hospital, and the units must be linked up to the general public health medical work now carried on, working in harmony with the general practitioners.

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PULMONARY TUBERCULOSIS IN RELATION TO
LIFE ASSURANCE.

By THOMAS DAVID LISTER, M.D., B.S., F.R.C.S.

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THE problem before the insurance examiner is so different from that of the pure clinician, that it is a matter of daily surprise to find that occasional examiners so often fail to realize the difference. Phthisis, as an extra risk in life assurance, has to be considered from two standpoints in regard to the individual proposer—firstly, has he ever had the disease; secondly, is he more than usually likely to get it?

Insurance offices are greatly affected by public opinion, but the new methods of dealing with tuberculosis have affected the practice of insurance offices much less than I thought would be the case nine years ago. In a post-graduate lecture, published in *THE PRACTITIONER* of November, 1903, I anticipated that the modern popular substitution of hope for the ancient attitude of despair in regard to consumption was having, and would continue to have, a far-reaching influence on the manner in which offices deal with the disease. I went on to discuss the methods of assessing the risk of phthisis, and the considerations that should enter into our minds in examining proposers.

But I have been disappointed. To-day, I recognize that, in spite of the great importance of the hygienist and immunist in modern treatment, such matters as hereditary and acquired vulnerability, and bad environment must still, in our insurance practice, be granted at least as much consideration as I then ascribed to them. They are the essential factors in the causation of infection by a bacillus which is ubiquitous, and afford us the measure of relative immunity in any individual coming before us for life insurance examination.

In fact, the therapist—of whatever kind—holds just the same position as he formerly did in regard to insurance. Always on the verge of showing that the disease need no longer possess terrors for the individual, yet we know that

improvements in death-rate are not to be ascribed to his efforts.¹ The merciless exposure by Professor Karl Pearson and others of the valuelessness of many medical "statistics," the studies of death-rates, and the experience of the offices themselves, leaves them untouched by the alleged progress of the art of *healing*. The great fallacy in the figures of results of this and of that method arises from the complete inability that is our lot in endeavouring to compare them with older or other figures, and diagnosis by tuberculin injections, for instance, and subsequent immunization of cases recognized thereby as tuberculous, affords no comparison with past, possibly bad (?), methods of recognition and treatment. How many of such cases, apart from the personal declarations of the many workers and sects in this field, would have required treatment, and have been claimed as "cures" when they got well, if they had escaped the needle? How many would ever have developed disease otherwise recognizable?

Without a doubt, a large and indefinite proportion would have shown no signs, or the observations of many pathologists, amply confirmed, must be ignored. Professor Osler² summed up his experience in the phrases, "The germ of tuberculosis is ubiquitous; few reach maturity without infection; none reach old age without a focus somewhere." The German proverb has it, "Jedermann hat am Ende ein Bischen tuberculose."

Carswell recognized from studies in pathological anatomy, in 1838, that pulmonary tuberculosis is curable. Professor Clifford Allbutt, in 1901, said—in a characteristically graphic phrase, "The computations of Birch-Hirschfield and others have placed beyond question that many persons were recovering from pulmonary phthisis under our eyes: our eyes were not open to see it." I need not refer to the equally striking statements of Brouardel and Grancher.³

To the confusion resulting from our habitual use, in clinical work and literature, of the phrase "carefully selected" (which means whatever we individually wish it to mean), I referred in an address on the "Problem of After-Care" at the Royal

¹ Bulstrode: L. G. P. Report, *Supplement on Sanatoria and other Aspects of the Tuberculosis Question*, 1908. Cf. also Professor Savarelli at Rome Congress, 1912.

² *First Annual Report of the Henry Phipps Institute*, 1905.

³ Quoted by Bulstrode, *loc. cit.*

Sanitary Institute in January of this year.¹ While statistics of cures are based on the "careful selection" of cases by experts of widely differing views, insurance offices will go on with their old methods of ignoring the claims of the varied modes of treatment. They will deal with their particular problem of assessing life-risks, not by the fact of a man having got well after an attack of phthisis, but by the attempt to judge the possibility of his dying from it before an age at which the premiums will have accumulated to the sum assured. Does he belong to a class with more than the average risk of dying of phthisis?

A past history of hæmoptysis, of pleurisy with effusion, of a stay in a sanatorium, raises doubts in the mind of an actuary, that medical assurances as to the completeness of recovery do very little to allay. The fact of the illness being recent would secure certain postponement for several years. At present, insurance offices are not prepared to have any confidence in any mode of treatment of tuberculosis. They will not, except under most exceptional circumstances, back it by offering a policy at ordinary rates to any proposer whose past illness was definitely or indefinitely diagnosed as pulmonary tuberculosis. The fact of recovery is taken as presumptive evidence that the patient has some natural resistance, but that it broke down once is more important to the office than the recovery. Lasting immunity in tuberculosis is not a good thing to lay long odds on.

This is the essential difference between the point of view of the pure clinician and the medical adviser of the insurance office. As practitioners, we rejoice in the cases we "cure," but in the very activity of our methods we often lose sight of the unknown factor of natural resistance, the loss of which was the real cause of the disease, and its gradual regaining, the real cure. "I dressed him, and God healed him," wrote Ambroise Paré, not knowing Ehrlich.

The absorbing clinical interest of the patients that respond successfully to immunization, whether by tuberculin, "auto-inoculation," or rest and feeding, causes us to lose sight of the vital resistance that aided us. That artificial tuberculosis immunity can be explained by the Ehrlich side-chain theory,

¹ T. D. Lister: *Lancet*, March 9, 1912.

which itself depends absolutely and centrally on an assumption of an unknown intracellular vital reaction, is not sufficient for insurance purposes. The insurance office must attempt to judge the proposer's liability to the occurrence of phthisis, and the further probability of early death, on the old lines, and I see no reason to depart from the suggestions I made in 1903.¹

An office has to consider the entire risk of a liability to early death from tuberculosis on three grounds, one, two, or all of which may exist in the proposer coming before us. The first, or hereditary vulnerability, may, as I endeavoured to show graphically in the paper referred to, be supposed to decrease during the course of life as a source of extra risk. The second, or acquired vulnerability, may be supposed to increase during life, if the proposer continues to be exposed to the causes of it. It includes drink, other poisons, chronic lung disease, and unhealthy environment. The third is a constant, striking at the natural resistance all through life, and is the danger of infection. This is possibly a little more intense in active adult life, and may be increased by many causes, such as co-dwelling with consumptives, by poor physique, and, so little faith is there in the permanence of acquired immunity, by a past history of the disease in the proposer.

So many individuals recover from tuberculosis without its being revealed during life, that a past history of revealed tuberculosis cannot be ignored. It means that the natural resistance broke down badly once. Why not again? The machinery has been proved to be defective or damaged. This point tends to be confused nowadays by the great number of "successful" cases of immunization, based on a diagnosis by the injection of tuberculin itself, as I suggested above.

Whether insurance offices will ever take up the question of insisting on certain proposers undergoing a regular course of tuberculin immunization, and regular re-inoculation after the first course is completed, is very problematical. The degree of natural resistance, as inferred, above all, by the present state on examination and the history of the "life," is for the present, and is, in my opinion, likely to be for

¹ A Table of the Factors to be considered in Various Kinds of Excessive Risk from Phthisis, *THE PRACTITIONER*, November, 1903, p. 683.

long to come, the basis of assessment of insurance risks. That some sound lives, showing at the time of examination none of the grounds which I mentioned for inferring an extra risk, should sometimes break down and die from phthisis, is beside the question. They are average risks to start with, and have an average chance of dying of this disease as of anything else. It is not an extra risk of so dying. But that is only an argument for insurance while in health, and, unless the offices adopt tuberculin tests, a very remote contingency, which would exclude some of those who reacted from insurance at average rates, this risk is one that they willingly run as often as sound lives present themselves. Indeed one school of tuberculin-therapists uses such large test doses at such short intervals, that in view of the known prevalence of latent tuberculosis, very few of the population would avoid being labelled as infected under the test.

Zeal outruns discretion in this, as in other things, and the Bosnian regiment, tested with tuberculin by Franzy, that showed over 60 per cent. of latent infection, would have afforded a fine group of successful results to any careful tuberculin workers.

A study of occupational mortality¹ shows that not only are some occupations enormously more liable to tuberculosis than others, but that the disease strikes with its maximum force later in life in some occupations than in others.²

Phthisis attacks those who are predisposed to it, whether by heredity, environment and all that that implies, or as shown by pre-existing tuberculosis, or brought about by pre-existing other disease. It is this predisposition—lack of natural resistance—deficient intracellular vital reaction to the specific antigen—the inefficient amount and nature of the “receptors,” etc.—which is the real disease, and at present it must be assessed for insurance purposes on the old lines.

The nomenclature of infection and immunity has overwhelmed the study of phthisis for the present. For clinical purposes, we may use such light as is thus afforded us, keeping our minds open with the ancient maxim, that what is new is not necessarily true, and what is true is not necessarily new.

¹ T. D. Lister: *Lancet*, October 15, 1910. *Transactions Second Congress on Industrial Diseases*, Brussels, 1910.

² T. D. Lister: *Life Assurance Medical Officers' Association Transactions*, 1912.

Practical Notes on Tuberculosis.

TREATMENT OF COUGH IN PULMONARY TUBERCULOSIS.

In a lecture at the Hôpital Beaujon, Professor Albert Robin pointed out that the cough in pulmonary tuberculosis is often useless, and ought to be treated. It may be laryngeal, tracheal, pulmonary, gastric, mediastinal, or pleural.

The *nervous cough* is very common. It occurs as the result of a tickling sensation in the larynx, and does not depend upon any organic cause. It may be treated by suggestion, for example, in the course of sanatorium treatment. The patient educates himself by his own will. If this treatment is not enough, recourse must be had to the following: Swabbing the throat with a 30 per cent. solution of potassium bromide, or taking 1 g. (gr. xv) of that salt in water.

The *pharyngeal cough* should be treated in the following way (the patient uses this gargle warm):—

℞	β-Naphthol	-	-	-	-	-	gr. ii j.
	Sodii Perboratis	-	-	-	-	-	℥ss.
	Aquæ Menthæ Piperitæ	-	-	-	-	-	℥vij.
	Aquam	-	-	-	-	-	ad ℥xxxv.

Misce. Fiat gargarisma.

If any inflammatory condition is present, the pharynx should be swabbed with the following:—

℞	Cocainæ	-	-	-	-	-	gr. ij.
	Resorcini	-	-	-	-	-	gr. xv.
	Glycerini	-	-	-	-	-	℥j.

Misce. Fiat collutorium.

In the case of pharyngeal irritation, the following gargle should be used:—

℞	Sodii Salicylatis	-	-	-	-	-	℥vj.
	Phenazoni	-	-	-	-	-	℥j.
	Aquæ Laurocerasi,						
	Aquæ Aurantii Florum	-	-	-	-	ana	℥ss.
	Glycerini	-	-	-	-	-	℥iiss.
	Aquam Destillatam	-	-	-	-	ad	℥xxxv.

Misce. Fiat gargarisma.

The *laryngeal cough* calls for the attention of the specialist. In the meantime, applications may be made of the following:—Orthoform powder, a solution of balsam of Peru, gomenol-water as a spray, or a

solution of coca leaves with carbonate of potash.

The following draught may be ordered:—

℞	Tincturæ Bryoniæ	-	-	-	-	℥x.
	Tincturæ Aconiti	-	-	-	-	℥xx.
	Tincturæ Belladonnæ	-	-	-	-	℥x.
	Syrupi Opii	-	-	-	-	℥i.
	Aquæ	-	-	-	-	℥iv.

Misce. Fiat linctus.

“One teaspoonful to be taken every two hours.”

The *tracheal cough* requires expectorants, and at the same time the tenacious sputum must be rendered more liquid. A useful mixture is one composed of infusion of senega, and of ground-ivy with Canada balsam, sweetened.

Or,

℞	Terpini Hydratis,				
	Pulveris Ipecacuanhæ Comp.	-	-	-	ana gr. ij.

Misce. Fiat pulvis.

“To be taken in a cachet two or three times a day.”

Or,

℞	Antimonii Oxidi	-	-	-	-	gr. xv.-xxx.
	Tincturæ Aconiti	-	-	-	-	℥xx.
	Aquæ Laurocerasi	-	-	-	-	℥ijj.
	Syrupi Opii	-	-	-	-	℥vij.
	Syrupi Ipecacuanhæ	-	-	-	-	℥ijj.
	Aquæ Tiliæ	-	-	-	-	℥iv.

Misce. Fiat mistura.

“Four, five, or six tablespoonfuls to be taken in the twenty-four hours.”

For the *gastric cough*, the following should be used:—

Ten minutes before each meal, 2 drops of Sydenham's laudanum (Tinct. Opii Crocata), or $\frac{1}{8}$ th of a grain of codeine, or, during the meal, make a few inhalations of oxygen.

In the case of the *bronchitic cough*, or of the cough due to compression, these pills should be ordered:—

℞	Extracti Opii	-	-	-	-	gr. $\frac{1}{6}$.
	Extracti Stramonii	-	-	-	-	gr. $\frac{1}{12}$.

Misce. Fiat pilula.

“Three of these pills to be taken at bedtime, two to be taken during the night, and from three to five during the day.”

Or, dionine may be given in pills, gr. $\frac{1}{6}$ to $\frac{2}{3}$, in the twenty-four hours.

For the *cough of pleurisy*, a counter-irritant is the most effective; iodine, the point of a cautery, or a blister.—(*Journal des Praticiens*.)

TREATMENT OF VOMITING DUE TO COUGH.

To prevent the vomiting frequently induced by coughing in tuberculous subjects, Garin and Rochais recommend the induction of sneezing by the

use of one or other of the following snuffs:—

R Fol. Lavandulæ.
 Fol. Melissæ,
 Fol. Menthæ Piperatæ - - - ana ʒj
 Glusidi,
 β-Naphthol - - - - ana gr. viij.
 Misce. Fiat sternutatorium.

Or:— R Pulv. Pyrethri Rad.,
 Pulv. Staphisagriæ Sem.,
 Pulv. Zingiberis - - - - ana ʒj.
 Misce. Fiat sternutatorium.

Or: R Pulv. Fol. Convallariæ - - - - ʒj.
 Pulv. Cubebæ - - - - ʒij.
 Pulv. Anisi - - - - ʒj.
 Misce. Fiat sternutatorium.

The snuff is carried about by the patient in a snuff-box, so that, when he feels that his cough is about to make him vomit, he may at once “take a pinch.” Most frequently, the vomiting after cough comes on about half an hour after a meal. Patients, who are not good observers of themselves, should be ordered to take a pinch of the snuff as soon as the meal is finished. Under these conditions all the cases treated have been successes. In 10 out of 15, the vomiting was permanently relieved. In other cases, the vomiting, which has occurred two or three times a day, has disappeared entirely after three or four days’ use of a snuff. The attacks have recurred from time to time, but never to the same extent or so often as before.—(*Le Progrès médical*.)

SAINT-CHAUVET'S “ZONE OF ALARM.”

Emile Sergent points out that examination of the apex behind gives the best results, when it is made in the area well to the inner side of the supra-spinous fossa, the region described by St.-Chauvet under the name of the “zone of alarm.” It is mapped out by taking the following lines: from the centre of the space separating the spinous apophysis of the 7th cervical from that of the 1st dorsal, a line is drawn as far as the tubercle of the trapezium on the spine of the scapula. From the middle of this line, taken as centre, a circle is described with a diameter equal to that of a 5-franc piece. The circumference of this circle forms the boundary of the zone of alarm. If a metallic mark is placed at the centre of this zone and a radiograph is taken, it will be found that the shadow of this mark exactly plumbs the apex of the lung, and that it corresponds, behind, to the area quite inside the supra-spinous fossa, and in front, to the area inside the supra-clavicular hollow, and some distance above the hollow of clavicle.—*Journal des Praticiens*.)

TREATMENT OF PAINFUL “POINTS.”

Paillard recommends a treatment, now ancient and almost forgotten, the injection of boiled water under the skin at the painful points on the chest-walls, so often found in tuberculous patients after pleurisy. He

has obtained results in his hospital practice, which have been remarkably effective and constant. The injection is slightly painful for the moment. The neuralgia passes off, as a rule, in from half-an-hour to an hour after the injection, and the patient remains free from it for a few days or even a week. Sometimes the relief is permanent, but more often it is necessary to have recourse again to the injection at the end of ten days or a fortnight. The quantity injected does not exceed 15 to 30 minims. In the case of dry pleurisy in the præcordial region, dry cupping or scarifications are better than the injection; but for all other painful spots, the latter is preferable and never fails, provided that it is made at the spot found by palpation to be the most acutely tender.—(*Le Progrès médical*.)

THE USE OF SUPRARENAL EXTRACT IN TUBERCULOSIS.

Sergent, for some time past, has made use of adrenalin and suprarenal extract in the treatment of tuberculosis. Suprarenal insufficiency is frequently present in tuberculosis, which is the better accounted for, because Addison's disease, in almost every instance, is connected with tuberculosis of the suprarenal bodies. Sézary showed the frequency of an inflammatory sclerosis of these bodies in tuberculous subjects, and supposed that this would explain the existence of slight symptoms of suprarenal insufficiency so often noticed in this disease. Boinet recently published a series of observations in which the symptoms of Addison's disease retroceded under the influence of suprarenal opotherapy. In these cases, it is really the extract of the whole capsule rather than adrenalin, which is more suited for the purpose. It is a question, not only of raising the arterial tension, more or less greatly reduced, but also and mainly to combat the condition of asthenia, more or less profound, which attracts attention from the first examination of the patient. Sergent has seen several tuberculous patients who have been benefited very greatly by the full extract, given in a dose of $4\frac{1}{2}$ to 9 grains a day, when adrenalin had only produced very incomplete and inappreciable effects. These observations were chiefly in connection with patients in whom the pulmonary symptoms were relatively small, whilst the loss of energy, the want of appetite, anæmia, and wasting were very marked. This is the condition in very many cases of pulmonary tuberculosis, and there is no need to jump at the conclusion of the presence of an hypertoxæmia, when it is only a matter of deficient suprarenal functions.

Sergent has also made use of the vaso-constrictor effects of adrenalin in tuberculosis. Adrenalin is one of the most powerful vaso-constrictors actually known. The vaso-constriction which it produces results, for the one part, in raising the arterial tension, and for the other promoting hæmostasis. Both these properties can find their therapeutic indication in tuberculosis just as they find it in a large number of other pathological conditions.

The angio- tonic effect can usefully be brought to bear in the case of cardio-vascular asthenia or collapse, on the presumption that such conditions can be set down to suprarenal insufficiency. Thus it is, that, under the influence of profound intoxication of the organism, of the extent of the lesion in the lungs, of the appearance of a pneumo-thorax, of the

compression produced by a large pleuritic effusion, we see supervene weakening of the myocardium, dilatation of the heart, collapse, and syncope. In all these conditions, independently of special indications, adrenalin will find its use, and can yield excellent service, whether given by the mouth in fractional doses, 5 or 6 drops of the $\frac{1}{1000}$ solution, every four hours, or whether prescribed in hypodermic injections, according to Josué's method, $\frac{1}{2}$ m.g. in half a litre of serum.

The hæmostatic properties of adrenalin have suggested the idea of using it for hæmoptysis in tuberculosis. Sonques and Morel, with hypodermic injections of $\frac{1}{2}$ to 1 m.g., stopped copious attacks in periods varying from twenty minutes to six hours. Bouchard and Le Noir stopped blood-spitting by instilling into the trachea 1 c.c. of a $\frac{1}{1000}$ solution. Finally, Vaquez did not fear, in several obstinate cases, to introduce directly into the lung from 8 to 10 drops of the $\frac{1}{1000}$ solution. In spite of these encouraging observations, this method of treatment has not become general; it may even be said that it has almost been given up. This is not to be wondered at when it is remembered that the vaso-constriction, produced by adrenalin, is followed by a no less considerable vaso-dilatation, and that, on the other hand, it is accompanied by a marked rise of arterial tension. The greater number of cases of hæmoptysis are combined with a condition of hypertension, it is, therefore, easily understood that a drug which promotes hypertension opposes the very object which it ought to effect. Consequently, adrenalin should only be used in those cases of hæmoptysis in which an examination of the tension has shown it to be decreased; but even with this reserve, Serjent thinks the drug dangerous in the hæmoptysis of tuberculosis, and has given it up.

It may, however, be given as an adjuvant of recalcification in the treatment of tuberculosis. In view of the favourable effects obtained in rickets and osteo-malacia, as well as in experimental fractures, Serjent thought to complete Ferrier's recalcification treatment in tuberculosis by giving adrenalin. For more than two years he has given it under these conditions to children and adults, and has used it in the most varied sort of cases—tuberculosis in the lungs, bones, peritoneum, and so forth. In all these cases, he has observed, almost without exception, a lessening of the phosphaturia and of the acidity of the urine. In a certain number of cases, he noticed a quicker appearance of the signs of recalcification; in others, he could see no apparent change; in several cases of phthisis, he has been obliged to break off the treatment because of the presence of threads of blood in the sputum and the threatening of an hæmoptysis. He obtained his most encouraging results in children, for one part, and on the other in tuberculosis of the bones and of the peritoneum.

The child rarely has hæmoptysis. The question arises whether the drug can be given for so long a time and in such large doses as in the adult; on the other hand, the fixation of lime salts is more active with them. Serjent attributes to these facts the superiority of the treatment for young subjects, aged under sixteen to eighteen years.

In adult phthisis, however, he also obtained, although less constantly, favourable results. But it is necessary to keep a strict watch on the arterial tension and the expectoration; very often, it is necessary to break off the

use of adrenalin so that its effect is not kept up long enough for it to act effectively.

In tuberculosis of bones, the results have been quite favourable, especially in Pott's disease; the same is the case in peritoneal tuberculosis, in which recalcification, which Courtellemont has shown to be efficacious, finds in adrenalin a most powerful adjuvant. To sum up, adrenalin will always be indicated, except in tuberculosis of the lungs in adults with hæmoptysis, as a potent factor in remineralization. It must be added, at the same time, that the indication for its use will be based upon the frequency of the failure of the suprarenal function in the tuberculous. It should be prescribed in a dose of from 1 to 2 m.g. a day, in fractional parts, in series of ten days consecutively, interrupted by a period of rest of from five to ten days. With these precautions, and under the reserve of the foregoing restrictions, the administrations may be kept up for a considerable time—weeks and even months—without observing any ill-effects.—(*Journal de Méd. et de Chir. prat.*)

REMINERALIZATION IN TUBERCULOSIS.

Professor Robin points out that powdered bones form one of the most important among the remineralizing agents. It forms the basis of all preparations for this purpose, for it supplies the patient not only with the phosphates and carbonates of lime and magnesia, but also with small quantities of fluorine and silica. The ordinary bone-powder, found in all pharmacies, prepared from calcined bone is of no use, for it has lost the activity of the complete bone, which represents a real opotherapeutic product. Powdered fresh bone is somewhat difficult to prepare, even when deprived of its fat, but it is much better assimilated and much more active than calcined bones, and all the pharmaceutical phosphates and carbonate of lime or magnesia. It has the disadvantage of only slowly saturating that acidity of the gastric contents, which plays so large a part in organic demineralization, and which is an obstacle to the assimilation of mineral elements. It is, therefore, better to add a small quantity of precipitated carbonate of lime, carbonate of magnesia, and a little lactose or sugar. It is also well to supplement the amount of fluorine and silica by adding fluoride of calcium and silicate of lime. Robin has, consequently, formulated the following:—

Powdered fresh bones	-	-	-	-	gr. xv.
Precipitated carbonate of lime	-	-	-	-	gr. vj.
Carbonate of magnesia	-	-	-	-	gr. iss.
Lactose, or white sugar	-	-	-	-	gr. xv.
Fluoride of calcium	-	-	-	-	gr. $\frac{1}{8}$
Silicate of lime	-	-	-	-	gr. ss.

To be mixed very exactly in a mortar for one packet. One of these to be taken at the end of each of the two principal meals of the day, mixed with a little Vichy water.

If any gastric disturbance is produced, this may be corrected by the addition of 3 grs. of bicarbonate of soda, and the reduction of the fluoride to $\frac{1}{4}$ gr. and the silicate to $\frac{1}{8}$ gr. (*Journ. de Méd. et de Chir. prat.*.)

AMBULATORY TREATMENT OF TUBERCULOUS JOINTS.

By C. A. HOEFFTCKE, 21, Woodstock Street, Oxford Street, London, W.

IN the treatment of tuberculosis of the joints the aim is to prevent friction between the articular surface of the joints. The splints hitherto in use are so devised that the necessary extension cannot be produced owing to the weight of the body being mainly transferred on the pubic bone and groin, which causes irritating chafing.

I claim for my extension splint that the weight of the body is transmitted on to the splint by means of the tuber ischia only, and that a continuous extension day and night can be maintained, thereby procuring complete rest in the joint. I also claim that with my splint the joint can be moved within a very short time of its application while the cure is progressing, and that even an ankylosed contracted knee-joint with considerable dislocation backwards can be straightened and made movable (see "Proc. Roy. Soc. Med., Clinical Section," May 14th, 1909).

The advantage of this treatment is that the patient is enabled to walk without crutches, or even sticks, while still maintaining extension, and without transmitting any weight on to the affected limb. Many eminent surgeons are treating their cases with my splint, and are delighted with the results obtained. The upright position and exercise while walking promotes better circulation of the blood, and the doctrine that the inflammation increases through movement being allowed in the joint, has been proved to be quite untenable when using my extension splint. It does not mean that, when my splint is applied for an active tubercular case, the joint should be moved at once; the treatment has to be carefully supervised. The joints and surrounding tissues have to be extended gradually, and as soon as the patient feels that he can move his joint without muscular nerve strain, or reflex of his muscles, the joint may be allowed a little movement, which should be gradually increased. A reaction from the pain and stiffness in the joint generally sets in within three weeks after the instrument has been applied; the swelling goes down, confidence returns, and the patient's general health improves; appetite increases, and the temperature becomes normal.

The cases which have been sent to me from the Hospitals were the worst that could be found, and I can safely maintain that the percentage of cures with my extension splint with good functional movement as the result, is the highest ever obtained by any treatment up to the present time.

It is also remarkable how eroded and deformed condyles will try to resume their normal shape, and how new bone will form and cover the eroded surface.

In Figs. 1 and 2 an active tubercular hip-joint is shown where my splint was applied when the head of the femur was nearly absorbed. The boy walked about on my splint like any other healthy child, and the movement in the joint was in no way restricted, with the result that two years after the application the splint was taken off, no trace of tubercular disease remaining. The new head which formed, although a little flattened, was covered with good bone, and there was absolutely free movement in all directions; a result of which the advising surgeon and attending doctor may be proud.

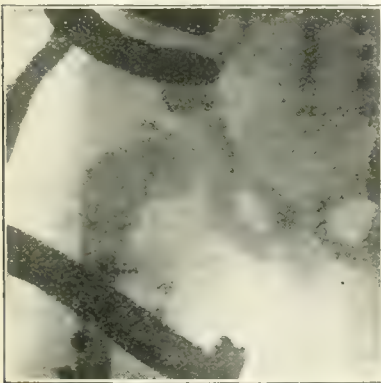


Fig. 1.—S.P. (æet. 7½). Active tubercular disease. Head of femur partly absorbed. June 1909.

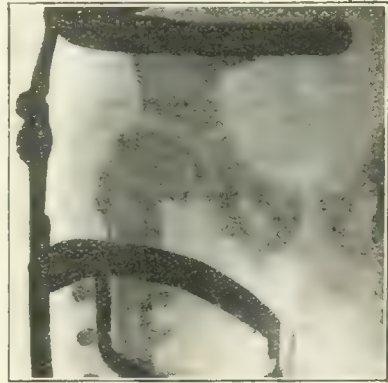


Fig. 2.—S.P. (æet. 9½). Head a little flattened but articular surface recovered. Free movement in every direction. July 1911.

APPOINTMENTS.

No charge is made for the insertion of these notices; successful applicants should send the necessary details without delay to The Editor, THE PRACTITIONER, Howard Street, Strand, London, W.C., to secure inclusion.

BOYD, SIDNEY, M.S. Lond., F.R.C.S. Eng., appointed Lecturer on Applied Anatomy, King's College (University of London).

BROWN, R. C., F.R.C.S., appointed Surgeon to In-patients at the Alfred Hospital, Melbourne.

BROWN, ELSIE, M.B., Ch.B., re-appointed First Assistant Medical Officer at the Manchester Children's Hospital Dispensary, Gartside Street.

BULL, DOUGLAS W. A., B.A., M.B., B.C. Cantab., M.R.C.S. Eng., L.R.C.P. Lond., appointed Medical Officer of Health to the Stratford and Wolverton Rural District Council.

BURNE, T. W. H., M.B., B.S., re-appointed House-Surgeon to St. Bartholomew's Hospital, Rochester.

CANDLER, A. L., M.B., B.S., F.R.C.S., appointed Medical Officer to the Exeter Dispensary.

CLATWORTHY, H., M.R.C.S., L.S.A., appointed Honorary Medical Officer, Granville Cottage Hospital, Auburn, New South Wales.

CONNOLLY, V. L., M.B., B.Ch., appointed Sixth Assistant Medical Officer of the Colney Hatch Asylum, vice H. C. Waldo, M.R.C.S., L.R.C.P., resigned.

COOLEY, P. G., M.B., Ch.M. Sydney, appointed Honorary Assistant Surgeon for Diseases of the Ear, Nose, and Throat to the Hospital and Asylum for Infirm at Rookwood, New South Wales.

DAVIDSON, ANDREW, M.D., M.S. Aberd., appointed Official Visitor to the Hospitals for the Insane at Callan Park and Gladesville and the licensed house for the Insane, Cook's River, New South Wales, vice James C. Cox.

DICKSON, ARNOTT, M.D., F.R.C.S. Edin., D.P.H., appointed Assistant Tuberculosis Officer to the County Council of Fife.

DOBSON, WILLIAM T., M.R.C.S., L.R.C.P., appointed House Physician at the Warneford General Hospital, Leamington.

DOUGLAS, G. A. C., M.B. Melb., appointed Resident Medical Officer, Brisbane General Hospital.

EDINBURGH ROYAL INFIRMARY.

—The following appointments have been made:—

Supervisors of the Administration of Anæsthetics: F. D. Cairns, M.B., Ch.B., to Dr. A. H. F. Barbour; Fergus Armstrong, M.B., Ch.B., to Mr. Brewis.

Non-Resident House-Surgeon: John Jameson, M.B., Ch.B., to Dr. Malcolm Farquharson.

Clinical Assistants: F. E. Reynolds, M.B., Ch.B., to Dr. W. T. Ritchie, M.W.R., and J. Donaldson Saner, M.B., C.M., to Dr. W. G. Sym.

ENGLISH, THOMAS CRISP, F.R.C.S. Eng., M.B., B.S. Lond., appointed Surgeon to St. George's Hospital.

EVERIDGE, J., F.R.C.S., appointed Sambrooke Surgical Registrar at King's College Hospital.

EVISON, F. A., M.R.C.S., L.R.C.P. Lond., appointed Certifying Surgeon under the Factory and Workshop Acts for the March District of the county of Cambridge.

FERGUSON, E. W., M.B., Ch.M. Sidney, appointed Assistant Medical Officer to the Lunacy Department, New South Wales.

FOX, W. T. B., M.B., M.S. Edin., appointed Certifying Surgeon under the Factory and Workshop Acts for the Blyth District of the county of Northumberland.

FRESHWATER, DOUGLAS H., M.A., B.C. M.D., appointed Physician to the Western Skin Hospital.

GAUNTLETT, E. GERALD, M.B., B.S. Lond., F.R.C.S. Eng., appointed Assistant Surgeon to the Paddington Green Children's Hospital, and Senior Surgical Registrar and Tutor at King's College Hospital.

GLASS, G. S., B.A., M.B., D.P.H., appointed Resident Medical Officer at the Purdysburn Fever Hospital, Belfast.

GRAHAM, T. O., M.D., appointed Assistant to the Throat, Nose, and Ear Department of the Royal City of Dublin Hospital.

GREER, M., L.R.C.P. Lond., appointed District Medical Officer of the Dolgelly Union.

HASLAM, IVY E., M.D., B.S. Lond., M.R.C.P. Lond., appointed Honorary Pathologist to the Warneford General Hospital, Leamington.

HAWKES, MARY COCHILL, M.D., appointed Superintendent of the Physical Exercises and Massage Department at the Royal Free Hospital, Gray's Inn Road, W.C.

HICKMAN, HERBERT V., M.B. Lond., M.R.C.S., L.R.C.P., appointed Honorary Anæsthetist to the Leyton, Walthamstow, and Wanstead Children's and General Hospital.



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APPOINTMENTS—continued.

HOLLOW, J. T., M.B., appointed Medical Superintendent at the Hospital for Insane, Beechworth, Victoria, vice A. W. Philpott, M.D.

HUNT, Miss M., M.D. Lond., D.P.H., appointed Junior Clinical Assistant to the Gynaecological Department, Royal Free Hospital, Gray's Inn Road, W.C.

JACKSON, D. J., M.D., B.Ch. R.U.I., appointed Second Assistant Medical Officer at the Mental Hospital, Whitchurch, Cardiff.

JEFFREY, GEORGE R., M.D. Glasg., F.R.C.P. Edin., appointed Physician-Superintendent to the Bootham Park Private Mental Hospital, York.

KAUNTZE, W. H., M.B., Ch.B. Vict. Manch., appointed Assistant Medical Officer of the Salford Union Infirmary.

KERR, HAROLD, M.D. Edin., D.P.H. Camb., appointed Medical Officer of Health for Newcastle-upon-Tyne, vice Dr. Henry E. Armstrong, resigned.

LAURIE, L., M.D., appointed Medical Officer of Workhouse and Scattered Homes, Medical Officer and Public Vaccinator of the Herne District of the Blean Union.

LEA-WILSON, B. H. C., M.R.C.S., L.R.C.P., appointed District Medical Officer of the Gainsborough Union.

LEE, D. CHISHOLM, M.B. Edin., appointed Assistant Medical Officer at the Warneford Mental Hospital, Oxford.

LLOYD, BERTRAM ARTHUR, M.B., B.S. Lond., F.R.C.S. Eng., appointed Resident Medical Officer at Charing Cross Hospital.

LONG, H. B., M.R.C.S., L.R.C.P. Lond., appointed Certifying Surgeon under the Factory and Workshop Acts for the Bicester District of the county of Oxford.

LUND, HERBERT, M.B., B.C. Cantab., F.R.C.S. Eng., appointed one of the Medical Referees under the Workmen's Compensation Act, 1906, for County Court Circuit No. 8 (Salford).

MACLURE, ALFREDE F., M.D. Melb., F.R.C.S. Eng., appointed Honorary Assistant Out-patient Surgeon to the Alfred Hospital, Melbourne.

MACPHERSON, D. A., M.R.C.P. and S. Edin., appointed Fifth Assistant Medical Officer of the Long Grove Asylum of the London County Council.

MANCHESTER ROYAL INFIRMARY.—The following appointments have been made:—

Assistant Surgical Officer: W. H. Hry, F.R.C.S. Eng. (reappointment).

Accident Room House-Surgeon: John Gow, M.B., Ch.B. Vict. (reappointment).

Director of the Cancer Research Laboratory: Dr. W. J. Reid.

House-Physicians: A. G. Wilkinson, M.B., Ch.B. Vict.; T. H. Oliver, B.A. Cantab., M.B., Ch.B. Vict.; H. B. Willis, L.M.S.S.A. Lond.

Senior House Surgeons: N. Duggan, M.B., Ch.B. Vict.; N. Matthews, M.B., Ch.B. Vict.

Junior House-Surgeons: R. P. Stewart, M.B., Ch.B. Vict., M.R.C.S., L.R.C.P.; K. D. Bean, M.B., Ch.B. Vict.

House Surgeon to Special Departments: F. S. Bedale, M.A. Cantab., M.R.C.S., L.R.C.P.

MARLE, SAMUEL, L.R.C.P. Lond., M.R.C.S., appointed Medical Officer for the Districts of Buckfastleigh, Dean Prior, and Holne, by the Totnes (Devon) Board of Guardians.

MASEFIELD, W. G., M.R.C.S., L.R.C.P., appointed District Medical Officer of the Stone Union.

MATHEWSON, H., M.B., appointed Medical Officer of the Norwich Parish Workhouse.

MILLAR, W. M., M.B., Ch.B., appointed House Physician at the Purdysburn Fever Hospital.

MILLER, B. C., M.B. Syd., appointed Ordinary Medical Officer, Granville Cottage Hospital, Auburn, New South Wales.

MOLLISON, C. H., M.D., appointed Clinical Pathologist, Women's Hospital, Melbourne.

MORTON, HUGH, M.D. Glasg., appointed Extra Honorary Physician at the Dispensary, Royal Hospital for Sick Children, Glasgow.

MURPHY, C. F., L.R.C.P. and S.I., appointed District Medical Officer of the Axminster Union.

MURRAY, T., L.R.C.P. and S.I., appointed Assistant Medical Officer to the Leicester Parish Infirmary.

NIALL, EUGENE M., M.D. Lond., B.S., appointed Honorary Physician to the Westminster General Dispensary.

OPIE, (PHILIP ADAMS, M.B., B.C. Cantab., appointed Resident Medical Officer at the Queen Victoria Memorial Hospital, Nice.

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PARROTT, J. N., M.R.C.S., L.R.C.P., appointed District Medical Officer of the Uxbridge Union.

PERKINS, HERBERT W., F.R.C.S. Eng., D.P.H. Lond., appointed Pathologist and Bacteriologist to the Hampstead General and North-West London Hospital.

PHILLIPS, G. R., L.R.C.P. Lond., M.R.C.S., appointed Anaesthetist to the Queen's Hospital for Children.

PHILPOTT, A. W., M.D., appointed Medical Superintendent at the Hospital for Insane, Ararat, vice Dr. Mullen.

RAY, J. H., M.B., Ch.M. Vict., F.R.C.S. Eng., appointed Medical Referee under the Workmen's Compensation Act for County Court Circuit No. 8 (Manchester County Court), vice Dr. G. A. Wright, resigned.

REEVES, T. C., M.R.C.S., L.R.C.P., appointed District Medical Officer of the Eastbourne Union.

ROBERTS, O. W., M.R.C.S., L.R.C.P., appointed Medical Officer of the Mary Place Workhouse of the Parish of Kensington.

SALTER, A. G., M.B., appointed Honorary Physician to the Brisbane Industrial Home, Queensland.

SANGER, F., M.R.C.S., L.R.C.P., appointed District Medical Officer of the Cirencester Union.

SANSOM, H. A., M.D., appointed District Medical Officer of the Hampstead Parish.

SHACKLETON, W., M.B., appointed District Medical Officer of the Billericay Union.

SPROTT, GREGORY, M.D. Glasg., appointed Honorary Medical Officer of the Hobart General Hospital, Tasmania.

STONE, F., M.B., B.S. Melb., appointed Resident Medical Officer, Lady Lamington Hospital, Brisbane vice Dr. Sweet, resigned.

SYDENHAM, FREDERICK, M.D. Edin., F.R.C.S. Edin., D.P.H., appointed Honorary Surgeon for Diseases of the Ear, Nose, and Throat at the Warneford General Hospital, Leamington.

THORP, H. P., M.B., Ch.B. Vict., appointed District and Workhouse Medical Officer and Medical Officer of the Children's Home of the Todmorden Union.

TODD, T. WINGATE, M.B., Ch.B., F.R.C.S., Lecturer in Anatomy in the University of Manchester, appointed Henry Wilson Payne Professor of Anatomy in the Medical Department of the Western Reserve University, Cleveland, Ohio, U.S.A.

TONKINSON, A. J., M.B., B.S. Lond., appointed Assistant Medical Officer of the St. John's Hill Infirmary of the Wandsworth Union.

UNIVERSITY COLLEGE HOSPITAL.—The following appointments have been made:—

Assistant Physician: T. Lewis, M.D., D.Sc., M.R.C.P.

Registrar of Anæsthetics: C. W. Morris, M.R.C.S., L.R.C.P.

Clinical Assistant to Ear and Throat Department: F. J. Cleminson, M.C., F.R.C.S.

Clinical Assistant to Skin Department: H. Samuel, M.R.C.S., L.R.C.P.

House Surgeon: L. A. Dingley, M.R.C.S., L.R.C.P.

YINING, C. WILFRED, M.D., B.S., M.R.C.P. Lond., D.P.H., appointed Honorary Physician to the Leeds Public Dispensary.

WARRINGTON, W. B., M.D., F.R.C.P., appointed External Examiner in Medicine in the University of London.

WATERHOUSE, W. S., M.B., appointed Assistant Medical Officer of the Workhouse of the Ecclesall Bierlow Union.

WATKINS, A. M., M.B. Melb., appointed Honorary Medical Officer, Wonthaggi Hospital, Victoria, vice Dr. R. H. Lewis, resigned.

WATT, JOHN A., M.B., Ch.B., D.P.H. Aberd., appointed Assistant County Medical Officer and Tuberculosis Officer to the Derbyshire County Council.

WATT, J. L., M.B., appointed Medical Referee under the Workmen's Compensation Act, 1906, for County Court Circuit No. 58, and to be attached more particularly to Tavistock and Okehampton County Court, vice A. E. M. Woolf, resigned.

WHITMORE, FIELDING, M.R.C.S. Eng., appointed Assistant Physician at Plymouth Public Dispensary.

WILLS, H. W. M.B., B.Sc. Lond., appointed Sixth Assistant Medical Officer of the Long Grove Asylum of the London County Council.

WILSON, D. R. L., L.R.C.P., M.R.C.S., appointed House Surgeon, Bollingbroke Hospital, Wandsworth Common, S.W.

WINTLE, COLSTON, L.R.C.P. Lond., M.R.C.S., reappointed Chairman of the Bristol Health Committee.

WOODCOCK, H. de CARLE, M.R.C.P. Edin., L.R.C.S. Edin., L.F.P.S. Glas., M.R.C.S., appointed Chief Dispensary Medical Officer by the Leeds Corporation Sanitary Committee.

YEARNSHAW, H., M.B., C.M. Glas., appointed District Medical Officer of the Salford Union.

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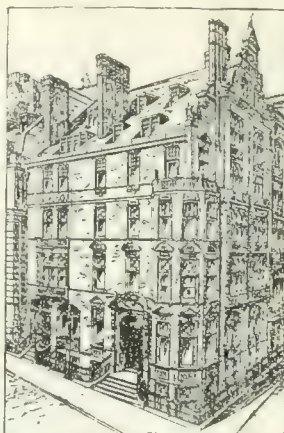
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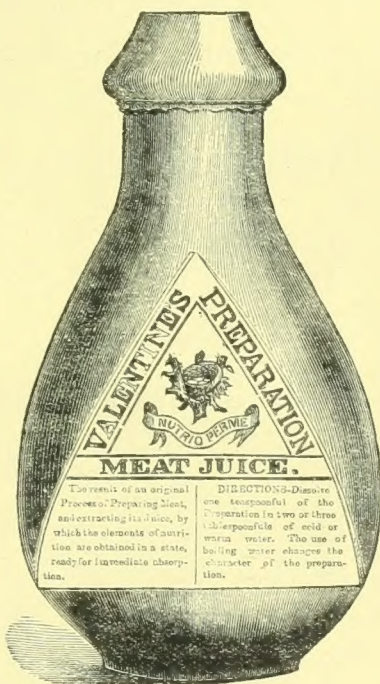
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